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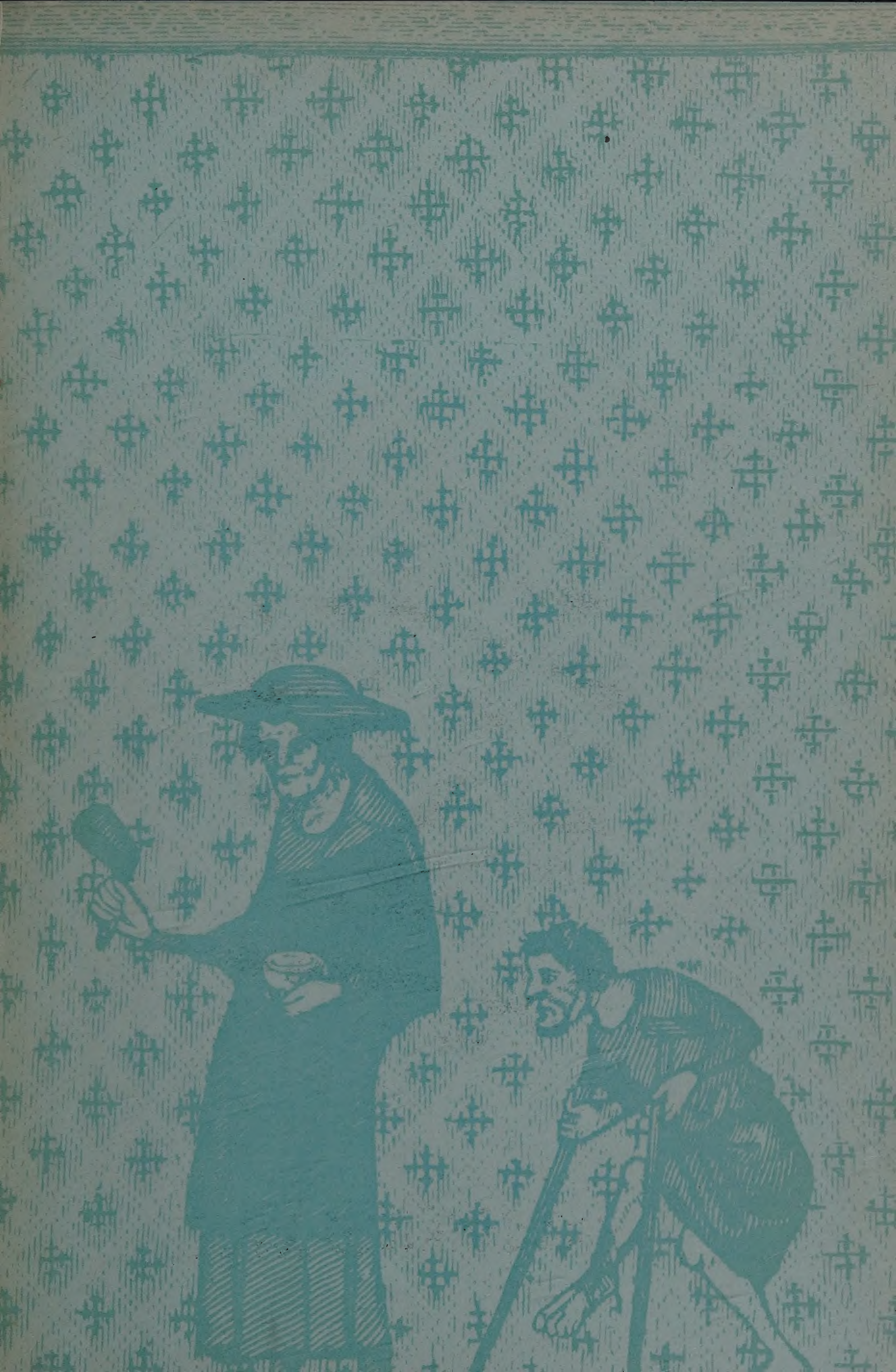

RIDERS OF THE PLAGUES

THE STORY OF THE CONQUEST OF DISEASE

THE BLACK DEATH

From a fifteenth-century woodcut used as a charm against a later epidemic of the plague. The man and woman lying on the ground are victims of the Black Death, while the second couple are appealing to St. Valentine for protection.

RIDERS *of the* ✠ ✠ ✠ PLAGUES

the Story of the Conquest of Disease

by

JAMES A. TOBEY

Doctor of Public Health

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FOREWORD

The names of twenty-one more or less forgotten heroes adorn the façade of the new School of Hygiene in London. Here on imperishable stone are writ the names of the riders of the plagues, the men and women whose glorious achievements have done the most to rid the world of many of its pestilences and to advance the cause of public health.*

These conquerors of the plagues may have ridden out of our ken but not out of our lives. Most of us owe to their valiant efforts our opportunities for healthful existence in a world which is undeniably a better place to live in because of their accomplishments. Because of their victories in that ceaseless, unrelenting conflict between man and his environment, modern life is longer and better and more enjoyable.

The story of health is not one of events only, but of men and women who have been responsible for some of the most dramatic events in human history. It is a narrative of many episodes in the variegated careers of these plague riders, incidents which often have the flavor of romance, frequently possess the thrill of adventure, and always are alluring in their fascination. The difficulty is to do justice to them with the written word.

By no means is this story of health merely a descrip-

* The names displayed are: Chadwick, Farr, Jenner, Leishman, Lewis, Lind, Lister, Manson, Parkes, Pringle, Simon, Sydenham, Biggs, Gorgas, Reed, Shattuck, Frank, Koch, Laveran, Pasteur, and Pettenkofer.

tion of medical triumphs. Tales of physicians may predominate, to a certain extent, but the riders of the plagues have been recruited from many professions. Thus, we see in the procession engineers, biologists, social workers, chemists, bacteriologists, and even ordinary laymen with no scientific background. This fact only adds zest to the story, for all persons of every age and every station in life are directly concerned in the movement for health conservation.

In our daily lives, each of us is striving for the same goal that was before the conquerors whose deeds are written in the following pages. Health is an individual as well as a public matter. Regardless of any real or assumed detachment about it, all of us are directly involved in the eternal warfare against the destructive forces of disease. The dawn is before us, too, as it always has been in the magnificent enterprises of those twenty-one heroes and many other men and women of all nations who have been and are the riders of the plagues.

James A. Tobey, Dr. P. H.

New York City,
March 24, 1930.

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OF THE PLAGUES

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I

GREAT PLAGUES OF THE PAST

HEALTH and disease have been important factors in the making of history. Plagues and pestilences have brought about far-reaching changes in the destinies of peoples and of nations, and great epidemics have nearly always preceded or followed important and decisive events, sometimes the cause and sometimes the result of occurrences which have influenced the progress of civilization. Thus, every great war of history has been accompanied or succeeded by the scourges of disease, and campaigns have been as frequently won or lost by plagues as by force of arms. The migration of races, the development of religions, changes in national customs, and the whole trend of history have been influenced by outbreaks of various devastating maladies.

More than once during its long existence has the human race been dangerously close to extinction. The cause of such near-annihilation has been an epidemic, or a series of outbreaks, which have swept across the world with an appalling momentum. In the Middle Ages the Black Death cut a swath in the population of Europe that approached human extermination. Six hundred years later influenza became berserk and removed its millions. Always, however, mankind has fought back, always has managed to survive, and usually has had among its numbers some who could ride the plagues and conquer them. The recital of these ex-

citing events in the subjugation of disease is the story of health.

The story may well begin with a description of some of the more serious and striking of the great pestilences of history. The narrative of the visitations of the various epidemics lends lustre to the romantical story of their eventual conquest, for man has vanquished nearly all of the diseases which once played havoc with civilization. If the detailed story were to be told in its entirety many volumes would be needed, for the number of recorded epidemics is astonishingly great. In 1800 Noah Webster, well-known compiler of the dictionary, wrote a "brief" history of epidemic and pestilential diseases which comprises two volumes, each containing more than 500 pages. Mr. Webster attempted to show that comets and other physical phenomena usually occurred about the time of epidemics, and to these meteorological influences he attributed the causes of pestilences. Nearly a century was to lapse after Mr. Webster wrote his treatise before the real cause of disease, the invasion of invisible but powerful germs, was to be so brilliantly demonstrated.

PESTILENCES OF ANTIQUITY

Advanced as was ancient civilization and modern as was its conception of some phases of sanitary science, every early empire was at repeated intervals swept by disastrous epidemics. The Bible, one of the world's most important historical documents, frequently mentions the pestilence, often in connection with famine and the sword. In the time of David, a thousand years before Christ, there occurred an epidemic which destroyed 70,000 persons in three days. The Bible says

(II Sam. 24) that when David was summoned to receive his punishment for numbering the children of Israel, he was permitted to elect one of the three calamities, famine, war, or pestilence, and that he chose the last, with the dire results mentioned. It is probable, however, that this plague, whatever its nature, came from Egypt, and did not arise spontaneously on account of the misfeasance of David.

A "sudden sickness" probably contributed to the disappearance of those remarkable early civilizations which existed in Central America. According to an ancient Chinese book, "The Shan Hai King," which describes the region lying beyond the Eastern Sea and no doubt refers to our own continent, a sickness of a peculiar darting nature attacked the refined and superior people who inhabited this country. A correspondent of the New York *Times,* Mr. Alexander McAllen, points out in the edition of February 15, 1927, of this newspaper that the ancient accounts of records in Yucatan and China agree in connecting the idea of a sudden pestilence in Central America, a sickness to which the ancient Mayans must have succumbed. The only existing trace of them consists of a few magnificent ruins. Disease has, unfortunately, too often been more potent than an apparently splendid civilization.

Rome and Greece were often visited by waves of disease, misfortunes which all of the great historians of those times, Ovid, Plutarch, Livy, Thucydides, Heroditus, and others, have vividly described. In the eighth century before Christ, Rome was devastated by a terrible epidemic, which swept away cattle as well as men. A few years later 185,000 of the Assyrian armies are said to have perished at the siege of Jerusalem, and this

same epidemic assaulted the inhabitants of Italy. In the reign of Tarquin, about seven hundred years B. C., there came another great famine and pestilence. The army of Xerxes was destroyed by disease in the fifth century while retreating from Salamis. Carthage was likewise subject to numerous epidemics during this century, while in 452 B. C. one-half of the people of Rome died of a pestilence. This calamity was succeeded by other epidemics, so that Livy called Rome a city exhausted by continuous burials—*urbs assiduis exhausta funeribus.*

THE PLAGUE OF ATHENS

The famous plague of Athens, so fervently described by Thucydides, began in 430 B. C., the second year of the Peloponnesian War. It continued without interruption for five years while a similar malady ravaged Persia at the same time. Artaxerxes, king of Persia, even invited the renowned Hippocrates to come over and rid his land of the epidemic, but that great physician refused with contempt the opportunity "to liberate barbarians from diseases while they may be the enemies of Greece." The exact nature of the plague of Athens cannot be gleaned from any of the descriptions of it, though the best opinion is to the effect that it was a form of the real bubonic plague. Other opinions are that it was typhus fever or even smallpox. The term "plague" is, of course, often used as a synonym for pestilence or epidemic, though there is actually a specific disease designated by that name, which occurs either in bubonic or pneumonic form.

From the plague of Athens to the beginning of the Christian era, there were, in addition to continuous

minor outbreaks, at least twenty-five notable epidemics, many of them world-wide in extent. They ravaged Rome and Spain, Greece and Asia Minor. One of the most interesting was that of 206 B. C., which occurred in Italy and was preceded by immense swarms of locusts. A pestilence of 126 B. C. was attributed to the stench of myriads of dead locusts, a factor which old Noah Webster considered quite logical. It is, of course, known to-day that odors do not cause disease.

The Christian era in Rome saw many more epidemics. Gibbon, the historian, writes that the period of the world in which the condition of the human race was most happy and prosperous was from 96 to 180 A. D., but Noah Webster, after studying the diseases of the time, retorts that the coloring given to the happiness of this period is too brilliant. Dr. Victor C. Vaughan in his work on "Epidemiology and Public Health" relates that this "most happy and prosperous period" was preceded by, begun in, continued in, and closed in pestilence. In the year 80 A. D. more than 10,000 deaths a day occurred in Rome from the plague and there were outbreaks at intervals for a century. The plague followed the Roman eagle throughout the world, 150,000 deaths occurring from this cause in Scotland in the years 88 to 92 A. D. An especially severe epidemic came in the reign of Marcus Aurelius and another in the time of Justinian. And so continues the story. As Dr. Vaughan says, the real conquerors of the Eternal City were not the Goths and Vandals, who pillaged it in the fifth century, but the plague and malaria, which ravaged it for many centuries.

THE DARK AGES

For a thousand years or more after Rome had become the prey of these Vandals and Goths, the world tried to forget sanitation as completely as possible. The greatest of the world's epidemics took place in that distressing period aptly known as the Dark Ages. In this era of uncleanliness and strife, the world paid its price for the abandonment of magnificent sanitary principles which had been developed in the civilizations of antiquity. The public sanitation of Crete and Rome, and the personal hygiene of the golden age of Greece, gave way to filth and its companion, disease. Pestilence reigned supreme, with leprosy following plague, with plague returning, to be succeeded in turn by syphilis, typhus, smallpox, and those strange scourges, the dancing mania and the sweating sickness. Europe was mad and man was groping vainly, trying to cope with enemies whose cause was not understood, with foes which man to-day holds in leash with an iron grip.

The history of the Dark Ages is one continuous story of pestilence, famine, poverty, and war. Periods of starvation often preceded, accompanied, or succeeded the great epidemics, and armed conflict was almost never absent. Among the most notable periods of famine were those in Egypt in 1064, lasting for seven years; other severe famines along the Nile in 1201 and 1264; the terrible dearth in England in 1069, and again in 1235 and 1257, again in 1314 when even the king, Edward II, went hungry; the cannibal days in France in 1030, and the almost constant lack of food during the days of the Crusades; the numerous famines in Ireland; and the frequent prolonged periods of hunger and

dearth in China, India, and Russia. Disease decimated the population, but famine was a close second, while war was, comparatively, only incidental as a slayer of humanity.

THE CRUSADES

The story of the seven Crusades from 1097 to 1270 A. D., is one not quite as much of romance and religious fervor as it is of disease and death. In 1073 the Seljuk Turks had taken Jerusalem and laid upon it the heavy hand of intolerance. Some years later the eastern emperor, Alexius, appealed to Pope Urban for aid against the invaders, and at a great church council held in 1095 the participants decided that strife amongst the various Christian nations should cease, at least temporarily, until the Holy Sepulchre was restored to Christian auspices. About this time pestilence and famine were, as usual, rampant, though somewhat more intense than customary. The people were restless and the idea of a crusade took hold with great popularity.

From Normandy and France, England and Flanders, Italy and Sicily, came these religious warriors in 1097. They crossed the Bosphorus and followed the route of Alexander the Great until they came to Antioch, which they besieged for a year. During this period the pest appeared and from September to the 24th of November is said to have caused the deaths of 100,000 persons. Antioch and, later, Jerusalem were taken, but at a terrible cost. In 1147 came a second Crusade, somewhat more stately as a military expedition, with an emperor, Conrad III, and a king, Louis VII of France, as participants, but no less deadly. A severe epidemic broke out in the army of Louis at Attalia in Asia Minor and depopulated that city.

In 1187 Jerusalem was retaken by Saladin, a Kurdish chieftain who had become ruler of Egypt. The Third Crusade thereupon began in 1189. It was a joint affair sponsored by the Kings of France and England and the Emperor Frederick Barbarossa, and its most romantic leader was the chivalrous Richard, called the Lion-Hearted. Again the grim spectre of disease accompanied the serried hosts and probably helped prevent the capture of the Holy City. Scurvy was one of the maladies which removed from 100 to 200 crusaders every day and also appeared, though somewhat less violently, in the armies of Saladin. This seems to have been the first instance of scurvy on a large scale, though this food-deficiency disease was to be met with frequently in future military expeditions.

The remaining Crusades, including that regrettable episode, the Children's Crusade of 1212, were steeped in disease, even if they did not amount to much as crusades. The Seventh and final Crusade, which was provoked by the retaking of Jerusalem by the Moslem in 1244, was commanded by Louis IX of France, who was taken prisoner in Egypt. Some years after his ransom this undaunted monarch set out by way of Tunis on another crusade and succumbed there of a pestilence said to have been dysentery. His son, Jean Tristam, was also a victim of this disease and the entire army was so severely attacked that it was impossible to bury its dead. Thus ended the Crusades. Their effects did not end for many years, however, and Europe basked in the pleasures of leprosy and other malevolent maladies spread and carried by the pious or adventurous hordes who had fought under various princes for the conquest of spiritual, but apparently not physical, things.

There was, however, one healthy aftermath of the insanitary Crusades, and this was the creation of a number of knightly orders interested in the maintenance of hospitals. In addition to the famous Knights Templar, a purely military society, there were the Hospitallers, or Knights of St. John, and the Teutonic Knights, whose main purpose was to aid and protect pilgrims and nurse the sick. The great Hospital of St. John at Jerusalem had been constructed by the merchants of Amalfi for sick pilgrims, but it passed to the Crusaders when the Holy City was taken in 1099 and was administered by these Knights of St. John (1211), to be later known as the Knights of Malta (1311), and still later as the Knights of Rhodes (1530). The Teutonic Knights grew up around the German Hospital of St. Mary's in Jerusalem in 1143 and around another erected at Ancre in 1190. During the next few centuries this order built castles and hospitals all over eastern Prussia. These edifices were about the only reasonably sanitary places in these unclean times, for they are said to have been equipped with bathrooms and water supplies, and with separate tower-latrines, flushed by running water.

SAINT ANTHONY'S FIRE

About the time of the last Crusade Germany and France were suffering from a strange disease called the fire of Saint Anthony. The name was due to an intense burning sensation felt in the extremities, with ultimate dropping off of toes and fingers, and the destruction of arms and legs. The last of the great outbreaks of this painful malady occurred in 1373 and was the thirtieth of a series of epidemics of it which began in 857 A. D.

and took place periodically thereafter, usually after intervals of twenty years or so. The disease was most severe in France, especially in Lorraine and the Loire district, with an estimated mortality of many thousands.

The cause of this disease was a poison due to the growth of a fungus on rye and some other grains. The fungus is known as ergot and the scientific name of the disease is ergotism. When eaten, this poison caused inflammation of the arteries of the extremities, shutting off the flow of blood and resulting in gangrene. Fortunately, it is now practically non-existent, though occasional outbreaks are said to occur in the peasant districts of parts of Russia.

Another of the distressing diseases of the times was Plica Polonica, manifested by matted hair. A severe epidemic, one of several, of this unsightly scourge occurred in 1287, having been introduced into Poland by the Mongol invasion of that year. During the Middle Ages, only eight diseases were considered contagious, including: bubonic plague, phthisis or consumption, epilepsy (which we know now is not communicable), scabies (syphilis), erysipelas, anthrax, trachoma, and leprosy. Many other diseases, such as influenza, measles, scurvy, and smallpox, were also prevalent.

Of the numerous epidemics, those of the Black Death and syphilis were the most terrible, while leprosy and typhus fever also caused great havoc. Many valiant efforts were made to succor the sick, especially by the various religious orders, such as the Benedictines, whose monasteries were provided with infirmaries. The trend of the times was, unfortunately, one of remedy rather than the more important phase of prevention and

prophylaxis. To-day people happily realize that the forestalling of disease is infinitely more significant to them than its cure or care.

THE BLACK DEATH

In the middle of the fourteenth century there descended on the world the worst disaster which has ever been experienced by man. This was a terrible epidemic known as the Black Death, which came nearer to the annihilation of the human race than has any other event before or since. The Black Death was bubonic plague and it was about three times as severe in actual mortality as was the frightful influenza epidemic of the World War period. The influenza of 1918 is estimated to have caused about 20,000,000 deaths, whereas the Black Death from 1348 to 1720 removed more than 50,000,000 people and the rate was, of course, greatly higher as the total population was very much less in the fourteenth century than in the twentieth.

One-quarter of the population of Europe succumbed to the Black Death. Not only did it cause this appalling loss of life, but the series of epidemics profoundly affected and changed the entire social and moral characteristics of the times. Beginning in 1347 in Sicily, the epidemic gathered terrific force and held sway for four hundred years. It ebbed and flowed, the intervals of intensity being due to a new population of the susceptible, ready for an onslaught as soon as general immunity had run out. Not until 1666 was England freed of this plague and then only by another disaster, the great fire of London. This conflagration apparently burned the rats which are known to be instrumental in carrying the disease.

Many vivid narratives of the plague have come down to us. The famous and also somewhat lecherous Decameron of Boccaccio was inspired by this epidemic, since the stories were supposed to have been told by various members of a party which had taken refuge in a country house near Florence. This author, whose father died of the disease, had also written a noteworthy account of the plague in this city. The epidemic in London has been graphically described by Daniel Defoe in his "Journal of the Plague Year" (1664–5). Readers of Poe will remember his striking tale, "The Mask of the Red Death." A first-hand description has also been left us by Gabriele de Mussi, a notary of Piacenza, who was an eyewitness of the first outbreak in Italy.

The Black Death apparently originated in the Orient, though there is evidence of other early severe epidemics of it in Italy as far back as 187 A. D. At any rate, the great epidemic made its way in 1347 from China to India, Persia, and Russia and thence by the main arteries of trade to Sicily. A Franciscan friar, Michael of Piazza, has quaintly written of this event that "twelve Genoese galleys were fleeing from the vengeance which our Lord was taking on account of their nefarious deeds and entered the harbor of Messalina. In their bones they bore so virulent a disease that any one who spoke to them was seized by a mortal illness and in no manner could evade death. The infection spread to every one who had any intercourse with the diseased."

So terrible was the early course of the Black Death in Florence that for some time the epidemic was called the Pestilence of Florence. In 1347 this city had suffered from a severe famine, in which 4,000 persons were said to have starved to death. As a consequence,

it was a fertile field for the plague, which began to spread in April of 1348. The physicians, not knowing the true cause of the disease, were helpless, and whether an individual took it or not was purely a matter of chance. To-day when disease is spread, it is usually due to somebody's carelessness, or wanton disregard of others. The mortality during the epidemic in Florence, as elsewhere, was very high, so great, in fact, that there was lacking sufficient consecrated ground in which to bury the dead, and eventually the corpses were left to rot in hovel and palace, for no one dared touch them. This was the case not only in Florence, but in Pisa, Venice, Rome, all of Italy, and everywhere that the disease laid its loathsome hand.

Although the poor, crowded in the most wretched and insanitary parts of cities and villages, were the chief sufferers, no class escaped. Kings and queens, princes and princesses, dukes and duchesses were numbered among the victims, and the list of celebrated persons who were killed by it is a tremendous one. In Paris, where the number of deaths was 80,000, two queens, Joan of Navarre, daughter of Louis X, and Joan of Burgundy, wife of Philip of Valois, were among the victims. Pope Clement VI, whose court was at Avignon, escaped the disease, having isolated himself and, on the advice of his physician, kept fires always alight in his apartments. This same physician, the famous Guy de Chauliac, contracted the disease, but was one of the fortunate few who recovered. Another royal victim was the Princess Jean, daughter of Edward III, who was en route through Bordeaux in 1348 to be married to the son of the King of Castille, when she died suddenly of the plague. Bishops and doges were stricken and no element of the population seemed immune.

In order to cope with the plague a sanitary council of three noblemen was instituted in Venice in March of 1348. This was the first board of health, though health officers had existed in early times. This board drew up regulations and isolated all people and merchandise from the Orient on an island. The period of isolation was for forty days, for no scientific reason, but because that was the duration of Christ's stay in the desert. This forty-day period gives us the modern word "quarantine" from the Italian of "forty." The powers of this sanitary council were increased from time to time and by 1504 it had become extremely influential as a political body.

Many other measures were instituted against the plague, which increased despite them. Thus, in one locality all concubines were to be expelled or married and a ban was placed on dice, the theory being that these instruments of worldly pleasure brought down the wrath of God. The concubines promptly got married and the dice manufacturers converted their wares into rosary beads. Some of the clergy attributed the plague to the pointed shoes which had come into fashion. The Protestants blamed the Catholics, who retaliated, and both accused the Jew and proceeded to wreak vengeance on the Ghetto. In England dogs were thought responsible. The interdiction of these and other sins caused the plague to abate not at all. The medical profession, helpless as it was, employed all kinds of fantastic remedies, and some of the physicians went about in bizarre costumes which earned for them the name of Beak Doctors. In London all houses which harbored plague patients were marked with a red cross and the legend, "God have mercy upon us."

As the epidemics gained momentum through the years, morals, already none too chaste, suffered a decline. Many persons gave themselves over entirely to dissolute orgies, believing that license and voluptuousness were the best medicines. Other groups went about scourging themselves until the blood ran, thinking thus to do penance for the sins which had brought on the plague. This flagellation was, as we realize to-day, a form of sexual aberration. The whole world seemed to have gone insane and well it might, confronted as it was with such a stupendous disaster.

The destruction caused by the Black Death varied somewhat in different parts of Europe, but was everywhere severe. The extremes are represented by the islands of Cyprus and Iceland, which are said to have been completely depopulated, and Germany, which lost only somewhat over a million people. The population of England is said by some authorities to have been reduced by half, while three-quarters of the people of France are estimated to have died, and Italy lost about half of its inhabitants. One result of this terrific loss of life was to make more valuable those who survived, so that workmen were treated with more consideration than ever before, a social change of some consequence.

To-day plague is confined to a few benighted areas of the world, chiefly in China and India. There was a serious flareup of it in 1893 in Cochin China and Hongkong, and during this pandemic the bacillus of the disease was simultaneously discovered by two scientists, Dr. Yersin from the laboratory of Louis Pasteur, and Dr. Kitasato, a Japanese physician, who was one of the assistants of Robert Koch. In 1900 San Francisco was threatened with an epidemic, though municipal officials,

for mercenary reasons, endeavored to conceal the facts. Prompt and vigorous efforts by officials of the United States Public Health Service, who had to intervene, averted a catastrophe. New Orleans has also been threatened with plague on several occasions, but aggressive measures have saved the situation.

Fighting bubonic plague means fighting rats, for the fleas carried by these rats disseminate the disease. Epidemics among the rats were noted even at the time of the Black Death, but it was not until 1905 that Dr. Liston and the India Plague Commission incriminated the flea. Another type of plague, the pneumonic form, is transmitted directly from one person to another. In addition to rats, the ground squirrels of California, the tarbagan of Manchuria, and certain other rodents are able to act as carriers of bubonic plague. There is a vaccine against plague, developed by Dr. Haffkine, which has been employed successfully. A severe recurrence of a pandemic of plague seems unlikely under modern conditions, but there are other diseases to take its place. Influenza is the Black Death of to-day.

THE DANCING DISEASE

Hardly had the first great epidemic of plague declined when another malady became prevalent in acute form. This was the peculiar dancing mania which overran Europe, particularly Belgium and Germany, in 1418, though not for the first time. It was really a severe form of the mild manifestation called chorea or St. Vitus' Dance, now encountered in a few individuals, but in the Middle Ages an occurrence of masses and mobs. The reason for this wholesale action was undoubtedly the mental condition of the people, worn out

by repeated disasters, especially the numerous epidemics of disease. Its cause was ascribed to the presence of demons and its sufferers indeed acted as if possessed by the evil one.

This Saint Vitus was a Sicilian who had undergone martyrdom during the persecution of the Christians by Diocletian in 303. Just before his execution he was reported to have prayed God to be able to protect those afflicted with chorea, a supplication which was answered affirmatively by a voice from heaven. Accordingly, he took his place among the fourteen saintly helpers of those days, along with Saint Martin, who was supposed to succor those with smallpox, and Saint Anthony, who was the patron for ergotism. The dancing malady was also called St. John's disease, on account of the bacchanalian festivals with which the day of this saint was celebrated by frenzied dancers, orgies which became so excessive that eventually St. Augustine had to warn against them.

The dancing mania began with epileptic-like convulsions, in which the victim fell to the ground, panting and foaming at the mouth, then suddenly leaped up and commenced to caper wildly about. Groups of persons would join in, dancing in weird delirium until they fell exhausted. With these symptoms went another discomfort, a distension of the abdomen known as tympany. In order to relieve this condition, dancers who had fallen to the ground were swathed in tight bandages, and bystanders often aided them with thumps and by trampling on the expanded parts.

These dancing epidemics continued for several centuries. Finally, Paracelsus, a radical physician of the sixteenth century, whose real name was Theophrastus

Bombast von Hohenheym, evolved an effective cure, consisting of heroic measures, such as immersion in cold water, followed by strict fasting in solitary confinement. Whether the cure, or fear of it, brought about a cessation of these crazy practices is a question.

Italy was smitten by a malady similar to the dancing disease of Belgium and Germany, though it was thought to be due to the bite of the tarantula. It was actually a mental aberration, but the term "tarantella" is still used for certain dances in that country, though the epidemics had subsided in the seventeeth century. A temporary flare-up of the same thing was the carmagnole of the French Revolution, and primitive peoples still have their hysterical dances, such as the tigretier of Abyssinia. A few years ago a marathon dancing craze occurred in the United States, but fortunately did not become epidemic.

THE SWEATING SICKNESS

Among the many afflictions of the Middle Ages none was more virulent than the mysterious sweating sickness, which appeared suddenly in the army of Henry VII in Wales. This disease singled out the robust and was characterized by terrific malodorous perspiration, along with other severe symptoms, and it was often fatal in twenty-four hours. At the end of that time either the patient or the sickness had come to an end. This first epidemic lasted a month, spreading to London and seriously interfering with the ceremonies following Henry's victory at Bosworth. It so dampened the ardor of the people that the king's coronation had to be postponed, and it further showed the contempt of disease

for persons in high places by killing two Lord Mayors and six aldermen within a week.

After a respite of twenty years, the English Sweating Sickness suddenly returned in 1506, though in milder form. In 1517 it was back again, this time with more severity, and in this year it went all over Europe. Henry VIII retreated before the disease, with more respect than he was later to show the Pope. In 1528 another epidemic occurred, again to the consternation of the redoubtable Henry, especially since a lady named Anne Boleyn, in whom he was then interested, contracted the disease. Her sickness called forth some ardent epistles from her absent monarch. The final epidemic of this *sudor brittanica* took place in 1551, carrying off, among others, the young Duke of Suffolk. An interesting account of the sweating sickness was given in 1887 in one of the unique Sette of Odd Volumes, only 133 copies of which were printed for the edification of the members of an exclusive learned society of Englishmen.

Sweating sickness does not now exist in epidemic form, though an outbreak is said to have occurred in France in 1906 or 1907. As miliary fever it does occur now and then in individuals.

THOSE WHO WERE SHUNNED

Leprosy was a common ailment during the Middle Ages and increased with considerable rapidity after the Crusades, possibly accelerated somewhat by the contact of the crusaders with the peoples of the Orient. From the stone landmarks of Babylon we learn that more than 3,500 years ago lepers were banished to the desert, there to wander and possibly become the prey

of wild beasts. Although Christ had preached mercy for those afflicted with this disease, the Christian Church promptly conducted the burial service over those who were found to be leprous, for henceforth they were civilly dead. The leper was forced to dress in a distinctive garb by day and carry a bell by night, so that all persons might shun him. He was permitted to speak to no one but other lepers; he could purchase food only by indicating his desires by pointing with a stick. Many legal restrictions, one of the most noteworthy being the leprosy decreta of the third Lateran council in 1179, were placed on these unfortunate people and a strict isolation and segregation of them was constantly enforced.

Lazar houses were constructed in large numbers during the eleventh and twelfth centuries until there were more than 2,000 of them in France alone. Great efforts were made to herd all lepers into these shelters, a system which was carried on without mercy for several centuries. This drastic method was borrowed from the code of Moses, and it was apparently successful in bringing about an eventual triumph over the disease. The great medical historian, Sudhoff, says that this was the first feat of direct prophylaxis in the world. The second was the introduction of quarantine, when Venice denied entry to infected ships and travellers suspected of carrying plague. Late in the fourteenth century Ragusa, in Dalmatia, required all those who had journeyed from plague districts to sojourn for one month in an isolation district before being admitted to the city. About this time Marseilles erected a quarantine station, where travellers and cargoes were detained for forty days. These were, however, about the only ink-

lings of preventive medicine in this whole disease-ridden period.

THE FRUITS OF COLUMBUS' DISCOVERY

When Columbus returned from his discovery of America, his men brought back with them something more important than the knowledge of the existence of a new continent. They returned with a malignant sickness which was then called by Spanish physicians "the reptilian disease" and by the Indians of Hispaniola, who had imparted it to the voyagers, *guaynaras*. In a few years this disease had become a frightful epidemic throughout Europe. The scourge got its start at Barcelona, even while Columbus was making his fervid reports to Ferdinand and Isabella. It received its impetus during the military expedition of Charles VIII of France, who, with a band of dissolute adventurers, marched on Naples in 1494. By the end of the fifteenth century this disease had spread throughout Europe. The malady is now known as syphilis, the worst of the venereal infections.

The term "syphilis" was not given to this disease until 1530, when an Italian physician wrote a poem about this dubiously poetical affliction. Prior to that time, each country named the disease after one of its enemies. Thus, in France it was called "mal de Naples"; in England it was known as "Spanish pox"; the Russians dubbed it "Polish Disease"; while the Persians spoke of "Turkish pox." The Italians got back at their northern neighbors by calling it "French Disease."

The disbanding of the army of the noble Charles was the event which bestowed this gift, via his Albanian and Roumanian estradiots and his German and

Swiss mercenaries, upon the susceptible population of Europe. The epidemic was very severe, much more virulent than the modern form of this endemic disease of our enlightened civilization, and many deaths were caused by the mediæval pestilence. Probably syphilis in a mild form had been prevalent in Europe several centuries before the voyage of Columbus, but after that event, it assumed a new malignancy and loathsomeness, which put it in a class with leprosy and plague as a most unfortunate and devastating disease. Some historians question whether Columbus' voyage did actually cause the epidemics of syphilis which occurred shortly thereafter. At any rate, the outbreaks did occur at that time.

THE MUCH DREADED RED CLOAK

At Granada there appeared in 1490 a spotted disease which did more damage to the Spanish soldiers of Ferdinand than did the shining swords of their Moorish opponents. This was *el tarbadiglo,* the red cloak, now commonly called typhus fever, an acute disease carried by the body louse, and having no connection with typhoid fever, which is quite another matter in spite of the similarity of names. The "red cloak" had been brought to Spain from Cyprus and from the end of the fifteenth century to the present day, it has been an accompaniment of armies and wars. During the World War, epidemics of typhus ravaged Serbia, Poland and Russia and caused great mortality.

In 1501 and 1505 typhus swept all over Europe. At that time it was called Hungarian Disease on account of the vast mortality of the German troops in Hungary, where they were fighting the Turks. In 1552 the Emperor Charles V was forced to raise the siege of Metz

on account of typhus, which decimated his great army, the largest which had been assembled anywhere for a century. Charles lost more than 20,000 men from typhus, dysentery, scurvy, and other similar calamities. The successful defense of Metz by the Duke of Guise, aided by the typhus which slaughtered the enemy, saved the whole of France from destruction and was an event of vast political significance. About this time 1,000,000 people were said to have been destroyed by typhus in Tuscany.

Jail Fever has always been another name for typhus, on account of its association with the overcrowding and squalor of the penal institutions of the past. Frequently attendants at courts of justice were the victims of the disease, contracted from prisoners. In England this happened so often during the sixteenth century that certain court sessions came to be known as the black assizes. Dr. V. C. Vaughan tells the story of one Roland Jenks, a Catholic who was accused of profaning the Protestant religion in 1577 in the reign of Elizabeth. During his trial, at which he was sentenced to lose his ears, it is related in the chronicles of the event that "an infectious damp" spread through the room. Shortly thereafter 600 persons sickened in one night and in about a month over 500 had perished. The Catholics were convinced that this was the retribution of God for the unjust sentence on Jenks, while the Protestants laid it to the diabolical influence of the Papists. This sort of bigotry has, let it be hoped, vanished as completely as has typhus from the United States. It is interesting to note that in the very year when this trial occurred, a great epidemic of typhus carried off some 2,000,000 Indians in Mexico, according to the writings of Padre Sabagun.

The Thirty Years' War, which began in 1620, and was fought mostly in Germany, reduced the population of that country by about half. As usual, typhus and plague, and other epidemics caused more deaths than did the sword. Gustavus Adolphus, the great Protestant commander, made remarkable provisions for the medical care of his troops, but in spite of all precautions, based, of course, on fallacious notions, typhus and other scourges were rampant and were disseminated widely by wandering bands of soldiers. The world was unquestionably a rotten place in which to live in those days.

This kind of thing continued throughout the seventeenth century, an era in which the people were endlessly harassed by war, starvation, and disease. These swashbuckling, roisterous, and insalubrious events went on likewise during the eighteenth and part of the nineteenth centuries, though fortunately in the middle of the latter period came the much needed sanitary awakening. By the seventeenth century leprosy had been stamped out, but plague was back again and typhus was omnipresent. Plague was tremendously fatal, taking off half a million persons in the Venetian Republic alone. Smallpox became epidemic in England from 1666 to 1675 and influenza and ergotism were common.

Hardly had the Thirty Years' War ended when Louis XIV of France went on a rampage in Germany. Typhus accompanied him, as usual, and was the uninvited guest at all the rest of the numerous wars of the following two centuries. No ruler was allowed to conduct his war in peace, but was continuously molested by this much dreaded red cloak. Even Napoleon had to put up with it in his campaigns, disease playing a most

important rôle in his failures in Egypt and Russia. Great commanders like Marlborough and Frederick the Great realized the necessity of good health among their troops and took rigorous measures for hygiene, but in spite of all precautions, diseases insisted upon spreading and epidemics would occur. The real causes of disease were, of course, unknown until the latter part of the nineteenth century when Pasteur made his remarkable discoveries.

In the eighteenth century Ireland was especially hard hit by the spotted fever, typhus. Irish troops, on account of their fighting proclivities, were in great demand as mercenaries, but their pugnacity gave them no immunity to disease. The louse, whose bite is now known to spread this malady, has always had a warm attachment for a fighting man. The many famines in Ireland and the distress induced by the repeated visitations of typhus caused a large proportion of the population of this otherwise attractive island to move over to America. Here again disease caused an event of some political significance, with the term "political" obviously possessing a special connotation.

Out of this chaos of epidemic and pestilence, the world, battered and bruised by its experience with many plagues, began to emerge toward the end of the nineteenth century into an era of better sanitation. In so doing, civilization was really only reverting to conditions which had existed in antiquity, for sanitation in early times was actually more "modern" than it ever was in the later Dark Ages. The interesting extent of sanitary science in the childhood of the race presents an unique story, a narrative, moreover, which offers all the glamours of the great episodes of history.

II

THE ANTIQUITY OF SANITATION

TWENTY-ONE and a half million years ago, longer than most of us can remember, there roamed on earth a reptilian monster called Dimetrodon by the geologists. The remains of one of these early inhabitants were discovered in Texas several years ago, which is interesting enough, but even more so is the fact that the skeleton, or what was left of it, gave evidence of a definite bone disease. This important discovery reveals the great antiquity of disease.

Somewhat more recent, dating back only fourteen million years, was a crocodile's fossil found in England. Here again were undeniable traces of disease apparently due to infection. Many other fossil remains of prehistoric animals have displayed such morbid conditions as dental caries and arthritis. The Dinosaurs and sabre-toothed tigers, and many other extinct animals apparently suffered from various diseases which, along with the ice, may have contributed to their disappearance.*

THE ANTIQUITY OF HUMAN DISEASE

No one can say definitely when man first appeared on earth, the estimates of the paleontologists varying from half a million to three million years. The first occurrence of disease is also unknown, but evidences of physical defects in the bony system due to infection

*Prehistoric and ancient disease is interestingly described by Colonel M. A. Reasoner in the *Military Surgeon* for September, 1929.

have been noted in at least four of the Neanderthal men, whose remains are thought to be about 200,000 years old. The later Cro-Magnon man, who existed some 30,000 years ago, was also plagued by disease, as shown in his skeleton. He certainly had pyorrhea, and other infections are probable. This remote ancestor of ours, the Cro-Magnon man, was no doubt often visited by epidemics of disease. He had no conception of sanitation as we know it, of course, but in those days when mind was first in the making, he must have learned that it was advantageous to avoid certain members of the tribe who were possessed of devils, or to put it bluntly, who were sick. This custom gave rise to a form of taboo, adopted eventually as a part of religious rites. Medicine, such as it was, and religion, such as it was in that dim past, were intertwined, just as they were for thousands of years thereafter, and even are to some extent to-day. It seems likely, however, that the hygiene instinct in man preceded the religious for, as Sir Andrew Balfour has well said, "There are many to whom religion makes no appeal, there are a few races of mankind which appear to be wholly devoid of any religious instinct, but even the most primitive, the most debased, practise certain laws of health."

The possibility that the Cro-Magnons avoided disease in prehistoric days is, of course, only an interesting speculation, though it is logical enough as an inference. There is no speculation, though, about the antiquity of sanitation. The ruins of the earliest traces of man show refuse heaps, indicating that even primitive man cleared out his caves and piled up his rubbish. The discoveries in the remains of the first civilizations indicate that the sanitary art was, comparatively speaking, highly de-

veloped. This is not speculation; this is historical fact. Let us examine some of the interesting details.

HOW OLD IS SANITATION?

Sanitation is generally regarded as a new science, as an art which has been entirely developed and even perfected in comparatively recent times. Many persons may, therefore, be surprised to learn that sanitation is not new at all, but an art with a heritage of thousands of years of actual experience and application. To be sure, there was a distressing interlude of several centuries when sanitation was forgotten and neglected, but its beginnings go back to the days of Imhotep and Ptolemy, to those of Hippocrates and Galen, of Moses and Asoka.

The story of health begins in the dawn of history, for it reverts to the time of those magnificent civilizations of six thousand or more years ago, those civilizations forgotten so long and revealed only so recently. The unremitting labors of the archæologist have uncovered traces of true sanitary science in the early empires of Assyria and Babylonia, in Egypt and Crete, in Greece and Rome. Sanitary science, dealing with the healthfulness of the environment and not solely with the individual, was developed far more extensively and efficiently by these olden people than was medical science, which was interwoven with magic and was thought by primitive races to be the gift of the gods.

History begins on the broad plain between the Tigris and Euphrates Rivers, now called Mesopotamia. Here was established some six or eight thousand years ago a civilization known as the Sumerian. Excavations have disclosed that the dwellings of the ancient Sumerians

were provided with drains and cesspools, not unlike those used by the modern Arab of the same locality. The terrain there was flat and sandy, so that this early attempt at sanitation was an individual and not a community venture. Public sanitation was introduced, however, by the successors of the Sumerians, for in the Chaldean-Babylonian and Assyrian Empires, with their great capitals at Babylon and Nineveh, respectively, sewers were constructed to serve the whole city, and water was brought from long distances through open channels. When it is considered that the city of London had no sewerage system whatever until the eighteenth century after Christ, the advanced sanitation of these cities of twenty centuries before the Christian era, cannot fail to stimulate our admiration.

HEALTH IN THE FIRST CIVILIZATION

The physicians of the Babylonians were also the priests, and cure was most often attempted by the exorcism of the demons of disease. Primitive man looked upon morbid conditions not as physical processes, but as the visitations of evil beings. In order to restore health, early man thought that the demon must be expelled from the body and that this feat could be accomplished by exhortations and charms, a trait still manifested among certain savage races. Not so very long ago even so-called enlightened peoples had similar ideas, and as late as the close of the eighteenth century a ceremony was held in England by seven priests for the purpose of casting out seven devils from an epileptic. The New Testament contains many references to this kind of preventive and curative magic medicine. The system is not entirely unknown to-day, for the

horse-chestnut in the hip pocket, the flaming vermilion underwear, and the wisp of saint's hair in a locket are still often employed as amulets against the modern demons of disease, "demons" which we now realize are actually living organisms which invade the human body.

The Babylonian charms and incantations were accompanied by a certain amount of inquisitiveness on the part of the priest-physicians concerning the anatomy of the human body, and as a consequence of this thirst for knowledge much was ascertained, though not always without some risk to the investigators. In 2000 B. C. the profession of physician had become somewhat perilous, for the famous code of Hammurabi, the earliest compilation of laws, contained severe penalties for medical malpractice. If a physician should operate on a man and cause his death or destroy his sight, it was writ that his hands should be cut off. If he caused the death of a slave, though, he need only supply another slave in his place, an excellent commentary on the relative value of human life in those days.

Discoveries made in the recently excavated city of Mohenjo-daro, situated on the west bank of the Indus, 1,500 miles from Babylon, have been described by Sir Arthur Keith in those words: "As regards sanitary engineering, this city of ancient Sind led the way; no city that can claim to be 5,000 years old so nearly approached our modern standard of sanitation as does Mohenjo-daro. We know how well laid were the bathroom floors, with latrines occupying recesses in the wall. We know the manner in which drains were laid beneath the house floors; they had vertical pipes which carried the effluent from the latrines and the overflow

of rain water to a brick-laid drain. A water chute was cut in the outer walls of the houses, and a great conduit was laid along the street to carry away the sewage. The street drains have been laid bare, and we can note the solidity of their workmanship and the even gradient of their fall. Last, we know how capacious were the main sewers, or drains, and manner in which their roofs were arched with corbeled bricks."

Compare these conditions with those slovenly, malodorous, wooden shacks with half moons for windows, which in the memory of many of us graced our own back yards as recipients of the human excreta of the greatest nation known to civilization. Can it be that America was only recently less advanced than Mohenjo-daro? It can be, and there are even localities to-day where conditions remain as primitive, almost, as in the days of Mr. Cro-Magnon.

EGYPTIAN SANITATION

In addition to the Babylonian, another great civilization of ancient times was that which flourished in the valley of the Nile some three thousand years before Christ. This is the land of the greatest structures ever raised by man, the Pyramids, and the world's most famous temple, Karnak. Our knowledge of ancient Egyptian customs is derived from the patient work of the archæologists and also from the writings of the Greek historian, Herodotus. He tells us that the Egyptians kept their houses clean, bathed frequently, and attempted to obtain unpolluted water. They worshipped the scarabæus, or dung beetle, possibly recognizing its scavenging powers and its contribution to a sanitary civilization. These people practised surgery and per-

formed circumcisions, a hygienic rite undoubtedly communicated to the Jews by their neighbors of the Nile. Mosquito nets were employed in Egypt, though possibly more for comfort than for sanitation, as the mosquito was not recognized then as the vector of malaria, a disease which, by the way, was never unduly prevalent in Egypt.

The Egyptians used many drugs in the treatment of disease and had an extensive pharmacopœia. Some of their remedies resembled those in favor many centuries later, though such items as the dung of the crocodile, have long since ceased to be included in any materia medica. There are some modern cures (?) almost as idiotic, it might be remarked in passing. Egypt produced the first physician who, as Sir William Osler has written, "stands out clearly from the Mists of Antiquity." He was Imhotep, sage, astrologer, architect, and magician, as well as physician, for scientists in those days were versatile. He was a contemporary of King Zoser (about 3000 B. C.), whose vizier he was, and several centuries after his death he was revered as a deity, the god of medicine. A temple in his honor at Memphis became in the sixth century B. C. a famous health centre and hospital.

The value placed on pure water by the early Egyptians is shown by their efforts to obtain it. Near the pyramids of Gizeh, which were built about 3000 B. C., is the well of Joseph. It is excavated through solid rock to a depth of nearly 300 feet, no mean engineering feat for those times, although an era which produced such massive tombs for its kings might well be expected to do something magnificent for the welfare of the living. The public hygiene practised by the Egyptians was, in

fact, of great influence on the customs of other peoples, such as the ancient Hebrews. The Bible tells us (Acts 7:22) that Moses was not only mighty in words and deeds, but "learned in all the wisdom of the Egyptians."

MOSES AND THE HYGIENE OF THE HEBREWS

The ancient Hebrews have been called the real founders of the science of public health. The laws of Moses, who was born about 1600 B. C., contained numerous hygienic precepts, many of them as well worth following to-day as when they were promulgated. The Hebrew civilization existed at least seventeen centuries before Christ, according to Egyptian manuscripts, and was contemporary with that of the Phœnicians, both occupying lands between the Mediterranean and the Arabian Desert, now called Syria and Palestine. The Hebrews carried on trade with Egypt and Babylonia, and their country served as the middle land for these two great empires.

When Moses adjured the people of Israel to obey the commands of God, he told them, as an inducement, that for such obedience, "the Lord will take away from thee all sickness, and he will put none of the evil diseases of Egypt, which thou knowest, upon thee, but will lay them upon all that hate thee." (Deut. 7:15). When he had completely set forth the laws, he admonished his people that if the commandments were not kept the Lord would smite them with various calamities, including consumption, fever, inflammation, fiery heat, the plague of Egypt, scurvy, and the itch, "whereof thou canst not be healed." (Deut. 28: 27.)

A large part of the Book of Leviticus is devoted to rules for the diagnosis by the priests of leprosy, plague,

and other diseases, together with regulations for the control of these afflictions. The venereal diseases also come in for explicit directions as to their supervision, and Moses proclaimed numerous rules on sex hygiene and moral relations. The laws also contain the well-known precepts on nutrition, still observed by orthodox Jews the world over. Moses evidently practised what he preached, for we are told that he was one hundred and twenty years old when he died and that "his eye was not dim, nor his natural force abated" (Deut. 34:7).

Practical ideas about the isolation of the sick and the sanitation of camps are illustrated in this passage taken verbatim from the Laws of Moses: "If there be among you any man that is not clean by reason of that which chanceth him by night, then shall he go abroad out of the camp, he shall not come within the camp; but it shall be, when evening cometh on, he shall bathe himself in water; and when the sun is down, he shall come within the camp. Thou shalt have a place also without the camp, whither thou shalt go forth abroad; and thou shalt have a paddle among thy weapons; and it shall be when thou sittest down abroad, thou shalt dig therewith, and shalt turn back and cover that which cometh from thee." (Deut. 13: 9–14.)

The Talmud contains many precepts on hygiene, especially with reference to the dietary. Not only are the allowable victuals enumerated in this sacred book, but the methods of keeping them were touched upon and advice given as to the manner of eating. Moderation and variety with respect to foodstuffs is recommended and fasting is stated to have its merits. "The best cure for a bad dream is a day's fasting," says the Talmud.

The ancient city of Jerusalem was well sewered and

possessed a good water supply. Previous to the eighth century before Christ this city had two aqueducts, one from the pools of Solomon and the other from the pools of Hezekiah, outside the city walls. In 727 B. C. King Hezekiah built a vast reservoir, called the pool of Siloam, near the gates of Jerusalem. The existing water being insufficient to fill the reservoir, he instructed his engineers to build a tunnel through the solid rock behind the city. The workmen began at both ends and met accurately in the middle, a task of no small magnitude when it is considered that only hand tools were employed.

A well more than 3,400 years old was discovered at Beisan in Palestine by the field expedition of the University of Pennsylvania which was working in this area in 1927. According to the director of the expedition, Mr. Alan Rowe, this well was forty-three feet deep and nearly three feet across. Its sides were lined with brick to a depth of thirty-nine feet. This Canaanite well is thought to be the oldest in Palestine.

From time immemorial has man been eager to procure an abundant supply of potable water. Besides these wells of Egypt and Palestine constructed in the childhood of civilization, other ancient wells have been found in China, in North America and elsewhere. Some time about 2800 B. C. when the Emperor Schin-Nung was preparing the first Oriental medical treatise, the Chinese were sinking wells 1,500 feet in depth, the deepest of all antiquity. In the valley of the Mississippi are driven wells which are believed to have been built by primitive peoples many centuries before Christ. In the Yucatan is a well bored vertically to a depth of 100 feet and then through a horizontal gallery 2,700 feet

long in order to reach water. Such water supplies as these were unquestionably pure, but for nineteen hundred years after Christ the purity of waters could seldom be vouched for, with the result that typhoid, cholera, and dysentery flourished. To-day we have about equalled the sanitary achievements of the Mayas, the Aztecs, and other forgotten peoples, at least with respect to the safety and potability of our water supplies.

THE SEA KINGS OF CRETE

The most elaborate by far of the sanitary engineering of ancient times was uncovered about twenty years ago on the island of Crete. Here was the mighty palace of Broad Knossus, home of the sea kings of 2100 B. C., and here is an amazingly complete and "staggeringly modern" system of drainage. Stone shafts brought rain water from the roof into a main conduit, three feet wide and half as deep, lined with smooth cement and provided with manholes. Terra-cotta pipes also fed this main drain, and these pipes were fitted perfectly one into another in a manner that few modern plumbers could duplicate. Bathrooms and latrines were everywhere, properly connected to the trunk line sewer. For three thousand years the palace of Broad Knossus remained incomparable with respect to sanitary engineering.

"From the open court to the east and the narrower area that flanks the inner section of the hall," wrote Dr. A. J. Evans, the archæologist, in 1908, "the light pours in between the piers and columns just as it did of old. In cooler tones it steals into the little bathroom behind. It dimly illumines the painted spiral frieze above its white gypsum dado, and falls below on the

small terra-cotta bathtub, standing much as it was left some three and a half millenniums back. The little bath bears a painted design of a character that marks the close of the great 'Palace Style.' By whom was it last used? By a queen, perhaps, and mother of some 'Hope of Minos'—a hope that failed."*

The historical connection of Crete with Egypt was found near the wall of another bathroom in this remarkable palace. Here was discovered the lid of an Egyptian alabastron, or small vase, displaying the cartouche of a king, evidently one of the Hyksos or Shepherds who overran Egypt about 1700 B. C. A similar figure on the breast of a carved lion was found in ancient Bagdad and is now in the British Museum.

PERSIAN PUBLIC HEALTH

After Egypt and Babylonia came Persia and Greece. The remarkable emperor, Cyrus the Great (559–529 B. C.), conquered the then civilized world, and one of his successors, Darius the Mede, made even greater conquests. It is said that Darius was first incited to attack Greece by a Grecian physician named Democedes who suffered from homesickness at the court of the Persian emperor. By a strange irony of fate, it was the prevalence of disease among the soldiers of Darius which prevented the success of the expedition. Cyrus, his predecessor, had been a wise commander who always took provisions and drinking water from home on his campaigns, and he required the drinking water to be boiled, apparently recognizing the sanative advantages of this process.

*Quoted from *The Times*, Aug. 27, 1908, by James Baikie in "The Sea Kings of Crete."

The philosophy of Cyrus with regard to military hygiene is illustrated by a conversation he is reported to have had with his father. "I have heard and seen," says Cyrus, "that those states which seek for good health educate physicians, and that commanders take with them physicians for the sake of the soldiers. I, too, therefore, as soon as my present expeditions were intrusted to me, gave my attention to the subject and thought that I had with me very competent physicians."

To which his father made this sage reply, "But these physicians, my son, of whom thou speakest, are like menders of torn garments, and thus, they cure those who have fallen sick. Thy chief anxiety should be to provide for health, for thou oughtest to take care to prevent the army from falling into sickness at all." And he is further reported as saying to Cyrus, "If you intend to stay some time in one place, you must not neglect the health of your camp. It is an easy matter if only care be taken." Many years later Aristotle is said to have written something to the same effect to Alexander.

THE GLORY OF GREECE

Three times the Persian hosts descended on the Hellenes and out of the third war, when Xerxes watched the dispersion of his hosts at Salamis, there emerged a nation. The Greeks had begun to develop a culture more than eight centuries before Christ, a period in which Æsculapius was the first great physician. As time went on this master of the healing art was revered as a god just as Imhotep had been in Egypt, and temples were erected to his memory. Mystic medicine was practised by the priests, but there were also physicians, most of whom were likewise philoso-

phers and scientists, unlike modern doctors, most of whom are neither.

The Greeks recognized the importance of health, and their temples were usually situated in groves, near springs, or by the sea. They employed heliotherapy, the sun-cure, which has only recently been scientifically proven to be of actual curative value. The ultra-violet rays at the invisible end of the solar spectrum are now known to cure certain diseases such as rickets, tuberculosis, skin disease, and other afflictions. At least one of the vitamins, those essential elements in human nutrition, is really hidden sunlight, and a coat of tan is one badge of salubrity. The Greeks did not know these scientific facts, but they did appreciate the health-giving qualities of sunlight, which to-day is no pagan fallacy.

Excavations at the ancient cities of Mycenæ and Tiryns, thought to have been founded in the fourteenth century before Christ, have revealed great bathrooms. In 625 B. C. an engineer named Eupalinius constructed a tunnel 4,200 feet long in order to supply water to the city of Athens. Greek engineers were also probably responsible not only for the sanitation of their own country, as at Ephesus, which was completely sewered, but for the first sanitary engineering of Rome and Carthage.

The fifth century B. C. was the golden age of Greece. It was the famous era of Pericles, a time when art and science made tremendous advances. Contemporary with Herodotus and Thucydides in history, with Æschylus, Sophocles, and Euripides in drama, with Pindar in poetry, and Aristophanes in wit there were many notable physicians, of whom Hippocrates was the foremost. Another was Empedocles, sometimes called the

first sanitarian for his services in altering a mountain so that the north wind blew away the plague from his native city of Agrigentum, in Sicily, and by diverting a river and draining a marsh near the neighboring metropolis of Solinus, thus freeing the town of a pestilence.

HIPPOCRATES, THE SANITARIAN

Hippocrates was the "father of medicine." He, too, was sanitarian as well as physician, and among his numerous literary endeavors he wrote three books on hygiene and sanitation. He was born at Cos in 460 B. C. and grew up at a time when cultivated man was no longer willing to ascribe disease to demonic causes, wholly external to the body itself. Hippocrates laid the scientific foundation for medicine and separated it not only from religion, but from philosophy. The Hippocratic oath is still administered to graduates of medicine about to enter the practice of that noble profession.

Like Æsculapius, Hippocrates was a luxuriantly bearded gentleman, with all of the poise and elan of the true doctor. He made his reputation when a young physician by prescribing a pretty nurse for an ailment of the king of Macedonia, a therapeutic device which, as sometimes happens, worked a marvellous cure. Then he strengthened his reputation by predicting a pestilence in Attica, an event which he deduced from the direction of the prevailing winds from a nearby outbreak of disease. It may have been that the epidemic was malaria and its spreading mosquitoes were carried on the wings of the wind. But after that Hippocrates was looked upon as the master of medicine.

The really great contribution of Greece to hygiene

was not so much the development of medicine as it was the creation of a marvellous system of physical education. Indulgence in athletics was the practical application of personal hygiene and the gymnasia soon acquired an importance equal to that of the temples of Hygeia. Democedes, whom we have already mentioned in connection with Darius the Persian, is alleged to have derived much of his surgical skill from the gymnasium, for the gymnasts treated sprains, dislocations, and fractures more ardently than did the physicians of those times. Democedes, it might be remarked, was one of the first health officers, serving successively as public physician at Ægina, Athens, and at Samos.

The pursuit of personal hygiene in Greece reached a perfection never achieved before or since. There was universal physical training for boys, "with a view," according to Dr. Karl Sudhoff, the eminent historian, "to the harmonious development of all the physical faculties and to the attainment of the greatest measure of strength, dexterity, and self confidence, of physical perfection and beauty. The system was founded upon daily exercise from earliest youth to ripe manhood, under the supervision of experienced and practiced leaders, who not only strove to make it viable and successful, but were capable of intelligent specialization, exacting from each physical entity the highest possible accomplishment, with constant reference to general vigor." The system dealt not only with exercise and athletics, but combined all parts of hygiene into a unified whole, stressing physical cleanliness, the care of the skin by bathing, swimming, and massage; and the regulation of diet, sleep, rest, and the sexual life.

All of the great Greek thinkers were interested in

health. Plato and Aristotle believed that no community could exist without health officers and such well-known figures as Epaminondas, Demosthenes, and Plutarch are said to have served in that capacity. Plutarch's rules of health are published and read even now, for they contain much wisdom. "Pleasure," wrote Plutarch, "is impossible without health." A valid axiom to-day.

The glory of Greece culminated in the career of Alexander the Great, who had conquered Persia and all the rest of the civilized world by the time he was about thirty years of age. He died in 323 B. C. at the age of thirty-three from a sudden fever which was more than likely an infectious disease. Forthwith, as Mr. H. G. Wells puts it in his "Outline of History," "the world empire he had snatched at and held in his hands, as a child might snatch at and hold a precious vase, fell to the ground and was shattered to pieces."

The passing of Greece, moreover, received a decided impetus from a microbic disease, for there is considerable evidence that malaria was introduced into Greece from Africa about the fourth century before Christ, or earlier, and that from then on the marvellous physiques of the Grecians began to succumb to the ravages of this scourge. Hippocrates described a remittent fever and remarked that persons who lived near marshes and drank the water from them got enlarged spleens, which is one of the symptoms of malaria. He deduced from his observations that there was a connection between the disease and the swamps, a connection which we know to-day to be due to the fact that *anopheles* mosquitoes, which carry malaria, breed in swamps, though the dissemination of the disease by mosquitoes was not discovered and proven until the end of the nineteenth

century after Christ.* At any rate, there is reliable evidence that malaria contributed to the passing of a civilization that was unmatched with respect to its system of physical hygiene, a fact which demonstrates that insanitary environmental conditions may change the whole aspect of history. Thus does a contemptible microbe undo that which the cunning of man contrives.

The empire of Alexander was divided into three parts after his death. Persia and adjacent domains went to one general, Seleucus; Macedonia was the prize of another, Antigonus; while Egypt fell to Ptolemy, who set up a great capital and centre of culture at Alexandria. He founded there the first extensive school of medicine. Two of the professors, Herophilus and Erasistratus, added something to the knowledge of anatomy by conducting experiments on living criminals. They justified this rather gruesome kind of vivisection by arguing that it was not a cruel act to seek remedies for innocent mankind throughout the ages by torture of a few condemned criminals. There were anti-vivisectionists in those days who protested lustily just as in modern times they oppose experiments on homeless dogs and otherwise useless guinea pigs, tests which may save the precious children of man from future suffering, pain, and death.

THE GRANDEUR THAT WAS ROME

As the empire of Alexander was crumbling there was rising on the shores of the Tyrrhenian Sea a new nation, destined to outshadow in some respects its forerunner by the blue Ægean. As the Greeks were noted in the history of health for their magnificent personal

*See page 169.

hygiene, the Romans were even more noteworthy for the splendors of their public sanitation. The city of Rome had a system of sewers as early as 800 B. C., while in 735 B. C. there was constructed the famous Cloaca Maxima, still in use after more than twenty-six centuries. It is twelve feet high, eleven wide, and when built was lined with cement. Every ancient Roman street had its lateral drain diminishing in size as the distance from the main sewer increased. Each house was connected with the sewer, though the system did not extend above the first storey, as it did in the palace of Broad Knossus at Crete. As a consequence, many Romans adopted the revolting habit, not unknown to-day in the slums of our own great cities, of casting forth the slops into the public streets, to the discomfort and detriment of the passer-by. This disgusting habit eventually became such a nuisance that a law was passed to prohibit it.

The rival of Rome was Carthage, a city famous in sanitary science for having the oldest known cisterns. They were eighteen in number, each 100 feet long and 20 feet deep. When Rome captured and razed this power in 146 B. C. these cisterns were, fortunately, not destroyed. Carthage also had an aqueduct leading from springs in the Zaghorn Mountains to the city, a distance of thirty-seven miles. The great aqueducts of all time were, however, those built by the Romans, whose engineering skill was never turned to better advantage than in the construction of these carriers of good health. Their own story has been vividly told by Frontinus, a hydraulic engineer and water commissioner who wrote in 97 A. D. "Will anybody compare the idle pyramids," he says, "or those other useless

though much renowned works of the Greeks with these aqueducts, with these many indispensable structures?"

The Romans became tired of drinking the water of the sewage-polluted Tiber some 300 years before Christ. Even before that time they had realized to some extent the value of pure water for they spent money on supplies from wells and cisterns. The Bible, incidentally, admonishes us, "Drink waters out of thine own cistern and running water out of thine own well" (Prov. 5:15). In 312 B. C. the first aqueduct was built by Appius Claudius, famous also for the great highroad which bears his name, the Appian Way. This stone water pipe was eleven Roman miles, each 4,854 feet, in length, most of it underground. During the next six hundred years there were constructed twenty aqueducts of varying lengths. Each builder seemed to try to outdo his predecessor, for the second, built in 272 B. C. by M. Aurius Dentatus, was 43 miles long, and the third by Quintus Martius Rex, was 61 miles in length. This one furnished the coldest water of them all and so was deservedly popular.

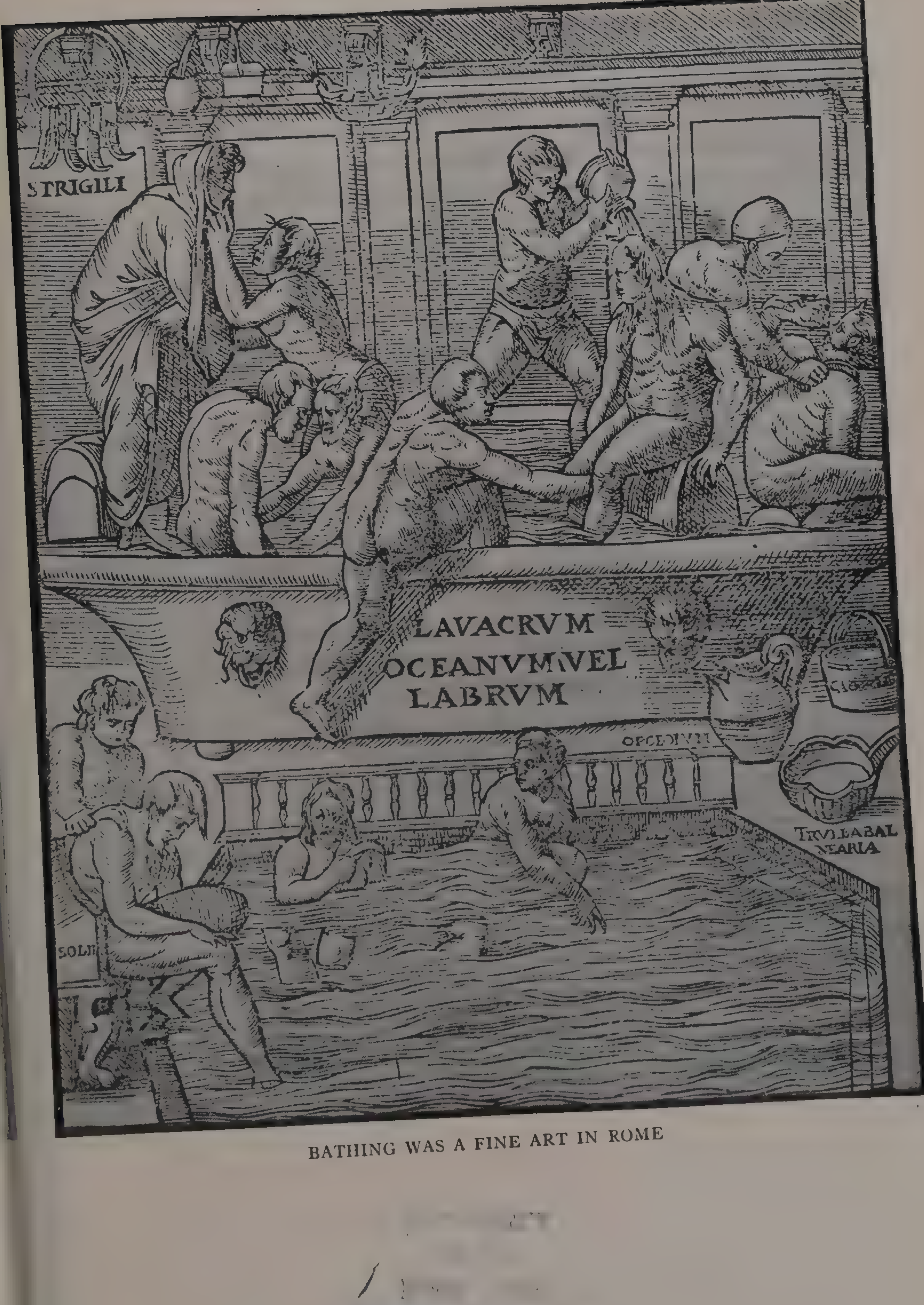
The Marcia and the next two aqueducts to be built, the Tepula in 127 B. C. and the Julia in 35 B. C., were joined near the city and carried along in three storeys, in which form they still exist in entirety and are familiar in the photographs of the Eternal City. Perhaps the best known of the aqueducts are the Claudio and the Anio Novus, completed in 50 and 52 A. D., respectively. The former was 46 miles long and the latter 58, and together they doubled the water supply of the city. In addition to the aqueducts in their own capital, the Romans also built them in their colonies in Spain, Africa, Greece, and France. Of these, that at Segovia

in Spain is the most perfect of the ones remaining. It is constructed of stone, without mortar, is 2,400 feet long, has 109 arches and at one point is 100 feet above ground. This remarkable structure is said still to supply the city with water.

Not only aqueducts, but also reservoirs, were built by the Romans. Most of them were public, but some were privately owned, as groups of individuals who had received a water grant would combine to maintain a reservoir. Each of the aqueducts was provided with a main reservoir and a number of smaller ones in the section supplied by it. On the Esquiline Hill was one of the principal reservoirs, which was 200 feet long, 130 feet wide, and covered with a vaulted roof, supported by 48 pillars. Possibly these Roman authorities understood the scientific principle that the storage of water in the dark inhibits the growth of the algæ and objectionable vegetable matter which sometimes causes tastes, odors, or colors in domestic water supplies.

Bathing was developed into a fine art in Rome and ultimately contributed to the downfall of the empire, not because bathing is in itself detrimental to health, but because the Romans made of it an effeminate luxury. Unlike the Greeks, who spurned warm water, the Romans used hot waters in their thermas and anointed the body with perfumed oils. Individuals each had their own implements known as body scrapers, made sometimes of gold, sometimes of silver, bronze, bone, or wood, according to the economic status of the bather. A patrician was scraped by a slave, a plebeian by himself, or his wife.

The baths themselves were constructed on a lavish scale, the largest, the Diocletian, having facilities for



BATHING WAS A FINE ART IN ROME

3,200 persons at once. The Caracalla, said to have covered a square mile of ground, could accommodate half as many again. In the latter days of the empire men and women bathed together promiscuously in public, and the therma became the club, the meeting-place, and forum for the whole populace.

The ruins of Pompeii, destroyed in 79 A. D., also contain magnificent baths. This city had a water supply which is estimated to date from the fifth century before Christ. It was provided with a great aqueduct and there was likewise a complete system of water-flushed latrines and sewers. The Roman system of sewage disposal differed from the Cretan of two thousand years earlier only in the fact that the former used running water from a city supply to flush the toilets, while the latter employed rain water. Both systems resemble our own and, for that matter, were far superior to anything we had until the latter part of the nineteenth century.

The fall of Rome was hastened by the appearance at various times of severe epidemics. Thus, in the second century after Christ, a great plague occurred throughout the empire during the reign of Marcus Aurelius, the philosopher-ruler. This same epidemic devastated China and threw into disorder the civilization which had arisen there. Malaria was also prevalent in Rome during the latter part of its history and this disease found a fertile field in a pleasure-loving decadent population, which had ceased to glorify strength and vigor. When the barbarian attacked in the early part of the Christian era he discovered a waning virility. Goths, Vandals, and Huns came in turn, with only an occasional set-back, such as that which occurred in

270 A. D. when the emperor Claudius defeated the Goths at Nish. This conqueror died shortly thereafter of the plague, a more formidable foe than the horde from the North.

MEDIÆVAL SANITATION

Barbarian sanitation was as bad as was the culture of these uncouth conquerors. With the passing of Rome, the world entered upon a period appropriately known as the Dark Ages. It was an era of filth and uncleanliness, of plague and pestilence. The princes of the church strove for purity of the soul, but often neglected the hygiene of the body, a matter which also seldom interested the potentates of empires. The world went from splendor into dreary disorder and dirt, not to emerge therefrom for a dozen centuries. Already the narrative of the great plagues of the past, with their accompanying social and economic implications, has been told in some detail in the preceding chapter. That chapter might logically have followed this one concerning the antiquity of sanitary science, but for the fact that the colorful story of the vanished pestilences and their accompanying disasters and destruction is a more appropriate introduction to the general narrative of the many climacteric events which eventually resulted in the conquest of most of these same plagues.

No really great episode of significance to the development of public health occurred during the Middle Ages, although some progress was achieved in medical science, and there was an actual, if limited, appreciation of organized public hygiene during the period of nearly a thousand years between the passing of the Western Roman Empire and the downfall of the Eastern Empire in 1453. Scientific thought was, in gen-

eral, dormant throughout these wretched centuries, with only one slight recrudescence, in the thirteenth century. The revival of learning did not come until the sixteenth century, when individualism once more triumphed over the collectivism and feudal domination of the mediæval era.

You may look in vain through most of the standard histories of the Middle Ages for any descriptions or comments on the health and sanitation of the times. The historians make much of wars and conflicts, of the personalities of popes and emperors, and even, occasionally, of the customs and economic conditions of the people, but few, if any, of these writers seem to consider hygiene of sufficiently memorable importance to be worth recording. Now and then a severe epidemic gets passing mention, the writers little realizing that these distressing events have often altered the whole aspect of history.

At least one protagonist of the Middle Ages has endeavored to prove that the period was not quite as dirty as it is usually painted.* He tells of numerous public baths in Germany in the fourteenth century, though he gives no evidence as to their size or as to how or by whom they were used. All of his contentions are, moreover, no more than generalities, and no better as evidence than the usual deprecatory descriptions of mediæval sanitation which he condemns.

In the thirteenth and fourteenth centuries, various cities, chiefly in Italy, adopted sanitary ordinances, or took other steps to deal with public hygiene. Thus, Bologna in 1214 appointed a city physician, and in the

*See Thorndike, Lynn: "Sanitation, Baths, and Street Cleaning in the Middle Ages and Renaissance," *The Speculum,* Vol. III, No. 2, April, 1928.

second half of the century a physician who had been archiater, or health officer, of Rome was elected pope, as John XXI. The English abbeys of this period had excellent systems of drainage and baths, and there existed many well-arranged and carefully administered secular hospitals, some of which were for the isolation of contagious diseases.

The introduction of a quarantine against plague by Venice in 1403 was a forward step, as was the establishment of a quarantine station at Pisa in 1464. Ragusa (1377) and Marseilles (1383) had put quarantine regulations into effect long before Venice, however, though the Venetian Republic usually gets the credit for this institution. Despite these occasional forays into the realm of public health administration, the Middle Ages were in no whit distinguished for any great contribution to sanitary science.

The sixteenth century was marked by many epidemics, as was also the seventeenth. The earlier century has to its credit, nevertheless, three outstanding medical leaders. Vesalius, who was the founder of modern anatomy; Pare, the plain man who made surgery a science, and deigned to treat common soldiers as well as great nobles and commanders;* and the bombastic Paracelsus who, as the people's physician, chucked much of the mediæval necromancy into the discard, though by no means all of it.

By the time of the seventeenth century, public health began to perk up a bit. The microscope was invented, the keeping of vital statistics was begun, and William Harvey demonstrated the circulation of the blood in 1616. A Puritan who was a trooper turned

*See page 136.

physician added something to preventive medicine and because of it deserves to be mentioned as we close the century. Thomas Sydenham, born in 1624, has been called by many the English Hippocrates, because he seemed to be the one bright medical light in a period which was medically all askew.

Before he became a doctor, Sydenham had fought with Cromwell. After he had matriculated as a physician the spirit of battle remained with him, for he began in 1661 to concern himself with the epidemics of London, which were, as usual, fairly numerous. The Puritans associated the Great Plague of London of 1665 with the evils of monarchy and while Sydenham, with proper loyalty, thought there might be something in this, he was also rather skeptical. He proceeded to study the natural history of disease and to put the various maladies into their proper pigeonholes. As a consequence he was the first to describe and differentiate many of the communicable diseases which are now well-known.

So great was the fame of Sydenham that his Dutch contemporary, Boerhaave, himself often styled the Batavian Hippocrates, is said to have raised his cap in awe and salutation whenever he mentioned the name of Sydenham. This great Englishman made many contributions to public health, though not enough to stem the ubiquitous outbreaks of disease. Epidemics continued to flourish throughout the seventeenth century, but the dawn of better things was not far off and already its faintly ruddy light was beginning to brighten a distant horizon. The dawn of public health was to reach full refulgence in the eighteenth and nineteenth centuries.

III

THE DAWN OF PUBLIC HEALTH

The science of public health has done more for the welfare of the human race than has any other science. This assertion may seem like a valiant one in the face of the remarkable progress and accomplishments of all branches of science and the inestimable benefits conferred by them upon mankind. Bold as is this statement, it is, nevertheless, one which can be supported by competent and adequate facts and arguments.

What other science can point to an increase in the span of human life as an achievement? During the period in which public health has been developing, the average length of life in the United States has increased by nearly two score years. In 1855 the expectancy of life at birth was only 40 years; to-day it is about 58 years, having increased to 43 in 1890 and to 49 in 1900. In the seventeenth and eighteenth centuries in Europe, human life was lengthening at the rate of only four years in a century. Now it is increasing in length at the rate of 40 years per century. Obviously, this means something to humanity.

Many factors, economic, sociological, and biological, as well as sanitary and hygienic, have, of course, contributed to this advance, but to public health as a science must go the major share of the credit. By reducing mortality and morbidity, and by increasing vitality and salubrity, public health has produced a longer and more robust span of life and has also made

the world a safer and better place in which to live. Compare our times with the pestilence-ridden centuries of the Dark Ages and all doubts are removed on this score.

Public health as a science is a modern development, though, as we have seen, the roots of sanitary science go down to the magnificent civilizations of antiquity. The greatest achievements in the prevention of disease, the prolongation of life, and the promotion of physical health and efficiency, matters of vital personal interest to all of us, have been effected within the last decade or so, though the foundation for these remarkable achievements was laid in the middle and latter part of the nineteenth century. Those were the days of the pioneers in public health and they builded well and firmly, with the result that you and I and the rest of us are enjoying a period of salubrity and safety which was undreamed of a century ago. Nor have the possibilities as yet been exhausted, for the future will witness even more brilliant accomplishments in this alluring field of life conservation. This chapter is, however, a narrative of the glories of the past. The future will take care of itself, but it is to the past that we must look for inspiration and interest, precedent and example.

THE SANITARY AWAKENING

Out of the welter of disease of the Middle Ages there gradually developed a sanitary consciousness, which began to make itself manifest about the end of the eighteenth century. Mankind had discovered that it was unprofitable and distressing to undergo the ravages of repeated epidemics. Such pestilences interfered with commerce and industry, with art and the advance-

ment of knowledge, with peace and happiness, and with the whole organization of society. Disease was the worst of the four horsemen of the apocalypse, that was certain, and forward-looking persons in England and America particularly, and to some extent on the Continent, decided that they had had enough of it.

As early as 1720 a treatise entitled "A Short Discourse Concerning Pestilential Contagion and the Methods to be used to Prevent It" was written by Dr. Richard Mead, the foremost English physician of the time. This little book of 150 pages was concerned chiefly with the plague, discussing its history, cause, control, and prevention. The work was so popular that it went into seven editions, which was a great many for a scientific book of those days. The idea that disease was entirely a manifestation of divine providence had been fairly well dispelled by this time, but the cause of plague and other maladies was now often attributed to the contamination of the air. Dr. Mead did not know, of course, that the real carrier of bubonic plague is the rat flea, but he did emphasize the importance of direct contagiousness and also the possibility of the infection being caused by rags, a contingency now realized to be of no consequence. His treatise was full of common sense, on the whole, and it reflected the new sanitary sensibility of the times.

Books on personal hygiene and sanitary subjects were not quite as plentiful in those days as they are now, when it seems as if nearly every physician and sanitarian, regardless of literary ability, is engaged in turning out volumes on this important subject. About a quarter of a century after Dr. Mead's contribution to sanitary science, there appeared another book which

was to exert a considerable influence on the hygiene of the age. A preacher and not a physician was the author of "Primitive Physick: or an Easy and Natural Method of Curing Most Diseases," and the clergyman in question was no less a person than John Wesley. His work dealt as much with physical matters as spiritual and he gave a set of useful rules on personal hygiene. Faith healing was not a fad of ministers of religion in those days and John Wesley had no illusions that mind was complete master over body, though he recognized, as do modern scientists, the important influence of mental hygiene. Wesley, it will be remembered, gave the world the aphorism that cleanliness is next to godliness. The next sanitary contribution, which took place in Devonshire, was the work of a physician instead of a preacher.

The cider of Devonshire was famed in verse and story. So was the Devonshire colic. About sixty cases of the disease were admitted yearly to the Exeter hospital alone and a Plymouth doctor reported that not a family escaped from this peculiar malady, characterized by colic and palsy. Then along came Dr. George Baker in 1767 and amazed and angered the good people of Devon by accusing their cider of causing the disease. It took a strong man to assault a beverage which was so revered, but the effect was somewhat ameliorated when the worthy physician assured the nation that it was not the cider itself, but the vessels in which it was kept. These were lined with lead so that the users of Devonshire cider were imbibing lead poison, thus causing plumbism. This work was an admirable instance of sanitary sleuthing, as it was a precise study of the cause of a specific disease.

A CLEAN-UP OF PRISONS AND FACTORIES

It was no joke to be an inmate of an English prison in the eighteenth century. The famous Black Hole of Calcutta was not much worse than a British jail of those days. Neither was it a particularly enjoyable occupation to be a factory worker, especially if one were a child, as were many of the persons employed in English factories of the times. By the nineteenth century, however, it had become almost a pleasure to be in either of these industrial institutions.

This part of the sanitary awakening was due to the efforts of a sheriff and a nobleman. The first of the great reforms was set in motion by one John Howard, who was appointed Sheriff of Bedfordshire in 1773. He was a new kind of prison official, for he actually took an interest in the penal institution over which he presided. He found it a filthy, stinking mess, into which all kinds of criminals, petty and felonious, were huddled, to emerge, if at all, broken in body and revengeful in spirit. Perhaps it served them right for breaking the king's peace, but this new sheriff was peculiar. He had his doubts.

Being of an inquisitive turn of mind, John Howard proceeded to make a personal tour of inspection of the jails of England and Europe. This trip was a most perilous one, for the investigator found himself constantly in the midst of excessively insanitary conditions, continuously exposed to typhus fever and other diseases, and overwhelmed by smells and putrefaction. It is said that he had to fumigate his notebooks before he could use them. He reported his findings to Parliament, which, unlike most legislative bodies in similar situa-

tions, proceeded to do something about it, possibly because they were shocked into action. Thenceforth English jails became more sanitary, an event which had no small educational effect on the large proportion of the population affected, directly and indirectly, by this reform.

Just as John Howard had been disgusted with conditions in penal institutions, so was the noble Earl of Shaftesbury shocked by disgusting disclosures as to the extremely insanitary conditions forced upon innumerable wretched children by unscrupulous manufacturers. These immature laborers often slaved for sixteen hours a day in poorly illuminated, foul-smelling, noisy factories and when this charming toil was over, they were packed into filthy barracks where they slept in relays in uncomfortable beds, beds which were never changed because never unoccupied. Such deplorable conditions were naturally conducive to disease.

Since sickness interferes with production and profits, besides spreading to the communities outside, the factory owners finally listened to the pleas and protestations of the humanitarian earl. It was strange in those days for a belted nobleman to give a rap about such proletariats as factory snipes, but this one was different. He insisted that something was going to be done and in 1802, after a vigorous report had been made in 1784, and much hullabaloo had arisen in between, Parliament passed the first British Factory Act. Thus began industrial hygiene.

Control of diseases in industry received a real impetus when a book on this subject was published by a man named Thackrah in 1831. He has been called the founder of industrial hygiene by such an eminent sani-

tarian as the late Professor William T. Sedgwick. Two years after the appearance of this book, the Earl of Shaftesbury managed to secure the passage of a really comprehensive factory law.

To-day nearly every employer of labor realizes that the health of his workers is one of his biggest assets. Great corporations have installed efficient medical departments in their plants and employ sanitary experts to supervise safety and hygiene. They do this because they have found by experience that an investment in the prevention of diseases and accidents pays dividends in increased production and more effective workmanship. It is a business proposition, just as the promotion and maintenance of personal health by each individual is good business.

CAPTAIN COOK AND SCURVY

Scurvy is a disease which has caused much havoc both on land and sea. From 1556 to 1877 there were recorded 143 epidemics of this nutritional disease on land alone. Frequently these outbreaks occurred in connection with military events, such as the Crusades or the numerous wars of the Middle Ages, though they also happened in jails and institutions where feeding problems were accentuated by crowded conditions. A scurvy epidemic reached serious proportions during the gold rush to California in 1849. On ships scurvy was an omnipresent menace, especially on long voyages, where sailors were fed on a fixed diet, lacking, as we know now the anti-scorbutic vitamin. Every explorer, from the days of Vasco da Gama, who sailed around the Cape of Good Hope in 1497, found scurvy to be one of his most troublesome passengers. The British navy, even under

such master mariners as Drake and Nelson, was ravaged by the disease until the end of the eighteenth century, when, as the result of a most significant episode, scurvy was practically banished from the high seas.

The events which dealt so summarily with scurvy were two voyages by that famous circumnavigator, Captain James Cook. In August of 1768 he had started out from Plymouth in the good ship *Endeavour* and a month or so later stopped at Madeira. There he sentenced a sailor and a marine to twelve lashes apiece for refusing to eat the fresh meat, onions, and fruits with which he had supplied the ship's larder. Not only did he enforce this order, but all the way around the Horn and across the Pacific he insisted that his sailors submit to his, to them, finicky ideas about victuals. He even made them suck lemons and eat sauerkraut and when he reached the South Seas he provided his men with cocoanuts and grasses gathered from the islands. He remained at fascinating Tahiti for three months and his men had no desire to grumble there, for they found myriad pleasures, as have many others since.

When Cook returned to England in 1771, after many strange adventures and important discoveries, including the passage between the two parts of New Zealand, and the Kangaroo, which was seen by white men for the first time on his voyage, he was able to report that he had conquered scurvy. His whole health record had, in fact, been excellent until he arrived at Batavia, where seven of his men died of dysentery. As a consequence of his exploits, Cook was received by the king and promoted to the rank of commander.

The second voyage of this hygienic explorer took him to the Antarctic and then again to Tahiti and its poly-

nesian charms. He was gone for three years and sixteen days. Only one man succumbed to disease during this whole period and that from a cause other than scurvy. When he returned to England this time, the Royal Society presented him with a gold medal and made him a Fellow as a reward for his achievement against scurvy. This was in 1776. The anti-scorbutic demonstration ought to have been convincing, but it was twenty years before the British made lemon juice compulsory in the diet of the navy, a dilatoriness which inspired some caustic comments from Herbert Spencer on the torpor of British administrative officials.

JENNER AND VACCINATION

The most prevalent and most feared of diseases for several hundred years prior to the beginning of the nineteenth century was smallpox. Unlike plague and other epidemic diseases, which came and went in wave-like outbreaks, smallpox was endemic, taking a continuous toll. No person seemed immune, the high as well as the low being afflicted. William the Third of England lost both his parents, his uncle, his wife, and two of his cousins from this cause, and nearly succumbed to it himself. Lord Macaulay in his history of England called the disease the most terrible of the ministers of death of the seventeenth century and described with much vividness its horrible effects. The New World was also much molested by this scourge and had to contend with it throughout the days of the colonies and the revolution. In 1717 Lady Mary Wortley Montagu, wife of the British ambassador to Constantinople, introduced into England the practice of inoculation, a system which had been known to the ancient

Chinese and other orientals, but even this had little prophylactic result on the disease as a whole.

Then, in 1796, came a discovery which could put smallpox almost completely out of business. An English country physician named Edward Jenner observed that dairy maids who contracted cowpox from cattle seemed immune to smallpox. This was not a novel idea, as a Dorchestershire farmer had noticed the same thing in 1774 and had actually transferred this cowpox virus to a human being, the first successful vaccination. A German physician had also vaccinated three children in 1791, but it was Jenner who put this theory to a practical test. One of the dairy maids had scratched her arm on a thorn and had infected herself with cowpox while milking. This happened in May, 1796, and shortly thereafter Dr. Jenner transferred some of the virus from the hand of this maid to the arm of an eight-year-old boy, James Phipps, with a typical "take" resulting. Then in the following July he inoculated this boy with variolous matter, taken directly from a smallpox patient. It will be remembered that inoculation was a common practice in those days, the theory being that the mild attack so caused would render the individual immune to a more serious form of the disease. At any rate, Phipps did not get smallpox, nor did he when the experiment was repeated a few months later.

Jenner then confirmed his test by inoculating smallpox virus into ten other persons who had previously had cowpox. Not until 1798, however, did he publish the results of his observations. Two years later Dr. Benjamin Waterhouse of Boston vaccinated his own son, who was five years old, and this was the first

known vaccination in America. It was followed in 1802 by the vaccination of 19 boys by Dr. Zabdiel Boylston, for whom incidentally, a street is now named in Boston. These boys were later inoculated with smallpox, but escaped the disease, though two unvaccinated boys, who were also inoculated, contracted it. From these experiments the Board of Health of Boston, of which Paul Revere was president, concluded that "cowpox is a complete security against smallpox." The new measure meant much to Boston, for in 1752 this city had had 5,998 cases out of a population of 15,684.

The theory of Jenner was put to further test in the years 1799 to 1801 when over 3,000 persons were first vaccinated and later inoculated with true smallpox at the London Smallpox Hospital. Without exception, the vaccination proved to be a complete protection. In the United States the process was championed by the president, Thomas Jefferson, who was himself vaccinated in 1806 and who wrote an enthusiastic letter to Dr. Jenner, hailing this discovery as the method by which smallpox would be stamped out. During the next fifty years great progress was, in fact, made in the extirpation of this "pitiless plague." Following the Franco-Prussian War in 1870 there was, however, a violent outbreak, due to the fact that the general reduction in the disease previous to this time, as a result of the vaccination practice, had given a false sense of security, which made the people careless and neglectful of the saving vaccination. This experience has been repeated since that time and for the same reasons.

Dr. Jenner is one of the great benefactors of mankind, as any one who has ever gone through an epidemic of smallpox will realize. It is said that Napoleon once

promptly released a political prisoner at Jenner's request, and the King of Spain did as much for a so-called Canadian pirate at another time. According to the story as related by Mr. Justice William R. Riddell,* the King of Spain had in 1803 sent an expedition to diffuse the knowledge of vaccination throughout his dominions in the new world. In a prison in one of these dominions, Mexico, languished Jeremiah Murray, who had participated in an unsuccessful attempt to free Venezuela from Spanish rule. Through the intercession of Dr. Jenner, the King of Spain set free the prisoner, who celebrated his release by being promptly lost at sea.

Although vaccination has proved itself beyond controversy as the only sure and safe preventive of the horrible smallpox, and as one of the great boons of mankind, there still persist a limited number of misguided persons who do not, cannot, or will not understand the value of vaccination. Individuals of average intelligence can be convinced of the efficacy of this important prophylactic measure when the true facts are laid before them, but there is a perverse minority which is usually opposed to all scientific progress, particularly as applied to medicine, and this deluded and bigoted group refuse to accept what is an established fact. With them it is a waste of time to argue. If they prefer to run the risk of smallpox rather than be vaccinated, that is their business, and they are entitled to die from this cause or be pock-marked, as the case may be. This philosophy applies to adults, but it is, of course, grossly unfair to young children whose course is mapped out for them by misguided or prejudiced parents.

***Canadian Journal of Medicine and Surgery,* October, 1929.

CHADWICK STARTS THINGS

From the beginning of the organization of society, the care of the health of the people has been recognized as the proper responsibility of the State, or sovereign power. This duty was realized in the great civilizations of antiquity, as has been shown, and even in the mediæval period, enlightened princes, of whom there were a few, endeavored to take some measures, usually superstitious and futile, for the prevention of epidemic diseases. Yet the Central Government of England was not concerned with public health at all when Victoria ascended the throne in 1837. To be sure, there was a so-called Quarantine Act, by which the Lords in Council were supposed to look out for maritime quarantine and go through the motions of dealing with threatened pestilence, but this was an inconsequential bit of legislation. Parliament did make annual appropriations for vaccine to be distributed to the public, but this was more eleemosynary than sanitary.

Within a decade all this had been changed and England had a real law and a real national board of health. Instead of public health being nobody's responsibility, it had come under the ægis of the sovereign power. This event marks the beginning of modern public health, and the man who engineered it is the founder of the sanitary movement. That man was Edwin Chadwick. Another man who was to lay the foundation for public health as a science was working at the same time in a dim laboratory in the *Ecole Normale* in Paris. That man was Louis Pasteur. More of him later; for the present let us see how Chadwick made public health definitely a part of political science.

Edwin Chadwick (1800–1890) was not a physician, but a lawyer, and in modern parlance he would probably also be called a social worker. It is strange how great a part has been played in public health by non-medical persons. As will be told later, the sanitary movement in America received its impetus from a statistician, Lemuel Shattuck, and engineers, biologists, social workers, and other scientists have done as much, if not more, for the general advancement of public health, as have the members of the medical profession. Edwin Chadwick got interested in sanitary affairs by serving as secretary of the Poor Law Commission in England. In 1838 he became impressed with the fact that poverty and disease were almost inextricably entwined, and for the first time in English history, physicians were employed to investigate the undeniable connection between ill health and the condition of the poor. The principal report was written in 1838 by Dr. Thomas Southwood Smith, author also of a popular treatise on health, but in 1842 Chadwick himself prepared a volume entitled, "The Sanitary Condition of the Labouring Population of Great Britain," a work which, as one part of a three-volume report to Parliament, exerted great influence on popular opinion.

So profound was the impression made by these reports that Sir Robert Peel appointed a committee of thirteen to consider public health in towns and populous districts. This commission rendered two reports, in 1844 and 1845, which aggregated 1,363 folio pages, besides numerous maps and illustrations. So well were these voluminous studies received that they were characterized as "certainly among the ablest and most comprehensive state papers that ever issued from a govern-

ment office." Such fulsome praise had never before been bestowed on a document relating to public health and this essential feature of government seemed about to come into its own.

Public health did achieve its well-merited recognition when on August 31, 1848, Parliament passed an Act for promoting the public health. Chadwick's efforts had come to fruition and he became one of the members of the first General Board of Health, along with the Earl of Carlisle, Lord Ashley, and Dr. Southwood Smith. Thus began the modern era of public health. It was not long, however, before difficulties were encountered. Chadwick was a man of vision, but he was impatient and he wanted England to make more speedy progress in health than the people were ready for. Consequently, his actions were somewhat despotic and the Board of Health fell into disfavor. Its career was terminated after six years, but public health suffered no serious retrogression, for, as Chadwick passed from the scene, his mantle fell to a most worthy successor, a man as fortunate in his ideals and as able in his performances as his mentor and predecessor. That man was Dr. John Simon, who served the cause of public health for the next twenty-one years. Before recounting the striking features of the career of this notable sanitarian, there should be related an interesting episode which belongs properly to this period in the story of health, and was one of the great achievements in the development of sanitary science.

CHOLERA AND THE BROAD STREET PUMP

Asiatic cholera swept down on London in 1854. The epidemic was violent, with a high fatality, but it was

chiefly remarkable for the analytical skill with which it was investigated and the successful determination that here was a definite instance of the spread of disease by polluted water. This brilliant piece of sanitary detective work, of a type which now goes by the name of epidemiology, was performed by Dr. John Snow, who had been appointed a member of an official cholera inquiry committee. Professor William T. Sedgwick, himself the greatest sanitarian of modern times, always considered this exploit the classical instance of sanitary research.

Dr. Snow lost no time in getting on the trail of this outbreak. His first action was to secure the number and location of the fatal cases. On proceeding to the St. James parish in Westminster, where the disease seemed localized, Dr. Snow soon discovered that nearly all the deaths had occurred in the vicinity of the Broad Street Well. He further found that most of the deceased persons had habitually used the water from this well for drinking purposes. Next he found that there had been no particular outbreak or increase in cholera except among persons who had imbibed at this disastrous fount. The circumstantial evidence was complete, but there were still other incriminating details. A brewery in the same neighborhood employed seventy workmen, but not one became ill, because they were allowed to partake of the pleasing product which resulted from their labors, and besides, they had a well of their own. On the other hand, a nearby cartridge factory, where the products made could not be used for quenching thirst, always kept on hand two tubs of drinking water, taken from the Broad Street Well. Out of about two hundred laborers here, eighteen died of cholera. There

was still further evidence, all of which Dr. Snow traced down with great assiduity. His activities were assisted and confirmed by a local clergyman, the Rev. Whitehead, who was also a member of the Cholera Committee, and by a surveyor and engineer, Mr. York.

In 1786 Lombardy had appointed a Director-General of Sanitation in the person of John Peter Frank, a Bavarian who was born in 1745. Frank made such a reputation in this capacity that the Emperor of Austria summoned him in 1795 to give advice on the health of his troops. From there he went to Vilna, and to St. Petersburg, where he died in 1821. Sir Andrew Balfour had characterized him as a hygienist who was far ahead of his period, especially in view of a remarkable work on public health which he published between 1779 and 1817. The man who followed him was Pettenkofer.

The knowledge that typhoid fever was a water-borne disease was later practically applied with telling results by this German sanitarian, Pettenkofer, who was another of the great epidemiologists. He came to the city of Munich in 1867 at a time when that metropolis had been drenched in typhoid fever for a decade. The city was honeycombed with privy vaults and shallow wells, the contents of all of which seemed to be thoroughly mixed. Pettenkofer induced the city to build a system of sewers to replace the privies, and also to obtain a pure water supply. The result was a prompt reduction in the annual typhoid death rate from about 203 per 100,000 population to almost nothing.

In spite of these tremendous benefactions, Pettenkofer was practically unknown by the people. The late Dr. Victor C. Vaughan relates in his memoirs that one day while en route to Pettenkofer's laboratory, he found

flags flying and bands playing and on inquiry was informed that it was the birthday of the insane king of Bavaria. When, however, he asked numerous persons how to reach Pettenkofer's office, none had ever heard of the eminent scientist. So it goes, a man who lowers a death rate remains unknown, but a crazy and useless monarch merits a festival.

SIMON CARRIES ON

Dr. John Simon had been serving as Medical Officer of the city of London for seven years when he was called in 1855 to the new office of Central Medical Officer of the General Board of Health. As health officer of London he had been one of the pioneers in public health, though Liverpool had preceded London by one year, in establishing its position of Medical Officer of Health in 1847, an office filled by Dr. W. H. Duncan. Simon was an able local official, but he achieved real greatness in his national position. He was not only a physician, but a teacher and a statesman, a rare combination.

Simon was a different type of man from Chadwick. He realized that sanitation in England could not be reformed over night, that, in fact, progress in public health was a matter of generations. He made strenuous efforts to secure new and effective health laws and in this regard was particularly successful. Many modern lobbyists would, no doubt, give much to learn his secret of persuading a slow-moving and deliberate legislative body like the English Parliament to promulgate what often must have seemed like radical laws. Simon stated, however, that there was "a huge legislative vacuum" and he proceeded to fill the void with a series

of laws, the culmination of which was the great Sanitary Act of 1866.

The Earl of Derby once remarked that sanitary instruction is more important than sanitary legislation. In this respect Simon was as great a molder of public opinion as he was a lawgiver. He saw that the people "had not reached any high standard of sensibility to dirt," though they waxed vehement enough against extreme atrocities of stench and filth, in which the times were not at all lacking. The comfort rather than the health of the people was annoyed, however, though to odors were ascribed many afflictions, accusations which we now know to be baseless, for a smell cannot cause disease. That brings us to the world's most famous stink.

THE MOST FAMOUS STINK

In 1858 the River Thames developed a stench so foul that it put to shame the fabulous aroma of the Augean stables. For months the topic was the sensation of the times, monopolizing the public prints, and calling down the wrath of the populace. "India is in revolt and the Thames stinks," was the classic utterance of a distinguished foreign writer. Dire results on the health of the city were predicted, for many persons, some noted physicians included, held that odors would surely spread all kinds of scourges. There were, in fact, two schools of sanitary thought, the group which may be called hygienic fundamentalists, and the sanitary modernists. The former led by a Dr. Murchison, held to the "pythogenic" theory, that is, that filth was not the carrier, but the source of disease and that bad air, particularly smells, spread typhoid, cholera, and every other ill.

The leader of the modernists was Dr. William Budd, whose studies on typhoid fever and other intestinal diseases were in a class with those of Dr. Snow of cholera fame. The evil consequences from the noisome condition of the Thames were actually not realized. Although the stench was said to be so bad that steamboat men on the river suffered from headache and nausea, and the atmosphere of Parliament could be rendered tolerable only by suspending sheets soaked in chloride of lime before each window, yet no serious results followed. When the returns from sickness and mortality were compiled, there was in reality a decrease in the death rate, and as Dr. Budd triumphantly wrote, "a remarkable diminution in the prevalence of fever, diarrhœa, and the other forms of disease commonly ascribed to putrid emanations."

In 1859 the Thames continued to be odoriferous, but conditions were improved. The reason for this two years' stink was the discharge into the river of the sewage of three million people, where it seethed and fermented under a burning sun. No wonder travellers, even those pressed for time, made circuits of many miles to avoid crossing the city bridges. The result was to show that odors do not cause disease, and thus was exploded another fallacy, a false opinion, however, which is not entirely dispelled even in modern times.

NEW ENGLAND FOLLOWS OLD

While Old England was making her progress in coping with the ubiquitous problem of disease, the people of New England, across the sea, were also learning the art of the conservation of health. Smallpox and cholera were problems in the colonies, later the states, just as

they were in London and other parts of England. In addition, the Americas had to contend with yellow fever and this disease in epidemic form in the West Indies gave rise to the first sanitary legislation of North America, a maritime quarantine act passed by the General Court of Massachusetts Bay Colony in 1647 or 1648. Yellow fever also brought about the creation of the first local board of health, established in Philadelphia in 1794.

Various sanitary ordinances were adopted from time to time in the early days of our country, in the provinces of Plymouth, Pennsylvania, South Carolina, and Massachusetts, though the last named was the first to pass a comprehensive law authorizing the establishment of local health organizations. Such a law was adopted in 1797 and in accordance with its terms, Boston in 1799 set up a board of health, with Paul Revere of midnight riding fame as its first president. Revere was one of the leading citizens of this metropolis and a merchant of parts, like John Hancock. The little wooden house in which he resided still stands in the somewhat unsavory North End, surrounded by brick tenements inhabited by recent Italian immigrants, some of whom seem to need the sanitary stimulus which Revere's memory ought to inspire. The Massachusetts law served as an example to other states, though progress was slow, for New York City did not have an efficient health organization until 1866 and Chicago none at all until 1867.

LEMUEL SHATTUCK PROPOSES

Due to the inspiration of the work of Chadwick and Simon in England, Massachusetts had appointed a

Sanitary Commission, which issued a most remarkable report in 1850. This statement was written by one Lemuel Shattuck and of it Professor C.-E. A. Winslow of Yale has written, "I am not quite certain that for breadth and clarity of prophetic vision it is not the most remarkable document in the history of public health." The late Professor George C. Whipple of Harvard wrote in 1917 that the outline was "so comprehensive that even to-day it may well serve as an ideal for future realization." Thus, we find Harvard and Yale in actual agreement, and if Princeton possessed a school of public health, one of its professors would no doubt be as profuse in his praise.

Lemuel Shattuck, like Chadwick, was not a medical man; he had been a school teacher and a publisher and when he prepared his survey was a statistician. He did not create his plan suddenly, it was a product of evolution, for in 1842 he had secured the passage of a law for the registration of vital statistics in the commonwealth and in 1845 he had made a sanitary survey of Boston. He was instrumental in getting the legislature to adopt the act of 1849 for the sanitary survey of the state, for which the munificent sum of $500 was appropriated, and he was appointed one of a committee of three to do it. Who were the other two does not matter, for although they signed the report, they contributed nothing to it and with respect to public health are nonentities, even though one of them was the governor. A few years later this same governor did not even recall having affixed his honorable signature to this momentous document.

Fifty recommendations for improving health conditions in Massachusetts were made by Shattuck in his

report, which comprises about 200 pages. There is no need to enumerate all of them here,* and it suffices to say that most of them have now been adopted. They were not put into effect right away, however, for, as Dr. Henry I. Bowditch of Boston wrote, the report "fell stillborn from the hands of the printer." Like all persons who are ahead of their times, Shattuck was treated with suspicion and contempt. The medical profession, with its customary arrogance, looked upon him as an offense, and the public, ignorant of hygiene and torpid, as usual, gave him no better treatment. Shattuck died before his plan was adopted and it was years later before he received due credit for his ideas. To-day he is recognized as one of the really great sanitarians of all time, a layman like Chadwick and Pasteur and Sedgwick and innumerable others, who rushed in where the medical angels feared to tread.

Not until 1869 did Massachusetts establish the state board of health, which was one of Shattuck's chief recommendations. This was the year, incidentally, when Charles William Eliot became president of Harvard University and set about making something out of the Harvard Medical School, which had been founded in 1782. Although Louisiana had had a temporary board of health, organized hastily in 1855 to cope with yellow fever, the Massachusetts organization was the first real state board of health in America. The example was soon followed by other states, California being the second, in 1870, and Virginia and Minnesota coming along in 1872. To-day every state has such a board or department, though some of them were rather dilatory about

*The report is reproduced in full in C. G. Whipple's book, "State Sanitation," Vol. II. Harvard, 1917.

the matter, and the last board, that in Texas, was not created until 1909.

THE NATIONAL BOARD OF HEALTH

Yellow fever, which had been coming and going in America since the earliest days of the colonies, descended with full violence in 1878. Evidently introduced from Cuba, this epidemic swept over the United States and was the worst visitation of the pestilence ever experienced in North America. The Southern states suffered most, but no part of the country escaped. This epidemic was mediæval in its splendor and since this was before the days when the cause and control of yellow fever had been discovered, health officials and physicians were helpless before it.

Such a calamity naturally provoked the attention of the President and of Congress. There had been a marine hospital service in the national government since 1798, though it had had no definite organization prior to 1870. In 1879 Congress created a National Board of Health, consisting of three medical officers from the Army, Navy, and Marine Hospital Service, a representative from the Attorney General's Office, and seven members appointed by the President. The board was directed to investigate all public health matters and to cooperate with the states in affairs of quarantine, still considered a state responsibility. From the beginning the board had a stormy career, due to the fact that the states would not concede that quarantine was of national scope, a fact which they did not wholly realize until 1893.

In 1882 the activities of the board were restricted to studies of only three diseases, smallpox, cholera, and

yellow fever. The emergency due to the epidemic was now past and Congress characteristically lost interest. No appropriations were made after 1884 and the board became dormant. The act creating it was not repealed until 1893, though in the meantime the Marine Hospital Service had assumed most of its functions. This service is to-day the United States Public Health Service, the principal, but not the only, health agency of the federal government. Later attempts to revive the national board of health were not successful. To-day sanitarians are agreed that there is no necessity for the United States to have a national health department, with a secretary in the President's cabinet, but they do feel most strongly that the health activities of the national government, now widely scattered in many departments, should be more efficiently coordinated.*

THE COMING OF THE DAWN

From the sanitary awakening in England in the latter part of the eighteenth century we have traced the development of public health down through the middle of the nineteenth. Not every incident has been described, of course, for space forbids, but the outstanding events have been chronicled. The work of Farr and others on vital statistics, the sanitary progress on the Continent, and the development of military hygiene by Sir John Pringle deserve mention in passing.

Here was a glorious background for the greater hygienic happenings which were to come. A strong foundation had been laid and the dawn was upon us, a pale light, perhaps, but with the sunrise just beyond. The

*See the author's book, "The National Government and Public Health," Johns Hopkins Press. 1926.

importance of the events of the period has been well expressed by Professor Sedgwick, who has written, "With the single exception of the change effected by the acceptance of the theory of organic evolution, there has probably been no modification of human opinion within the nineteenth century more wonderful, or more profoundly affecting the general conduct of human life, than that of our attitude toward the nature, the causation, and the prevention of disease."

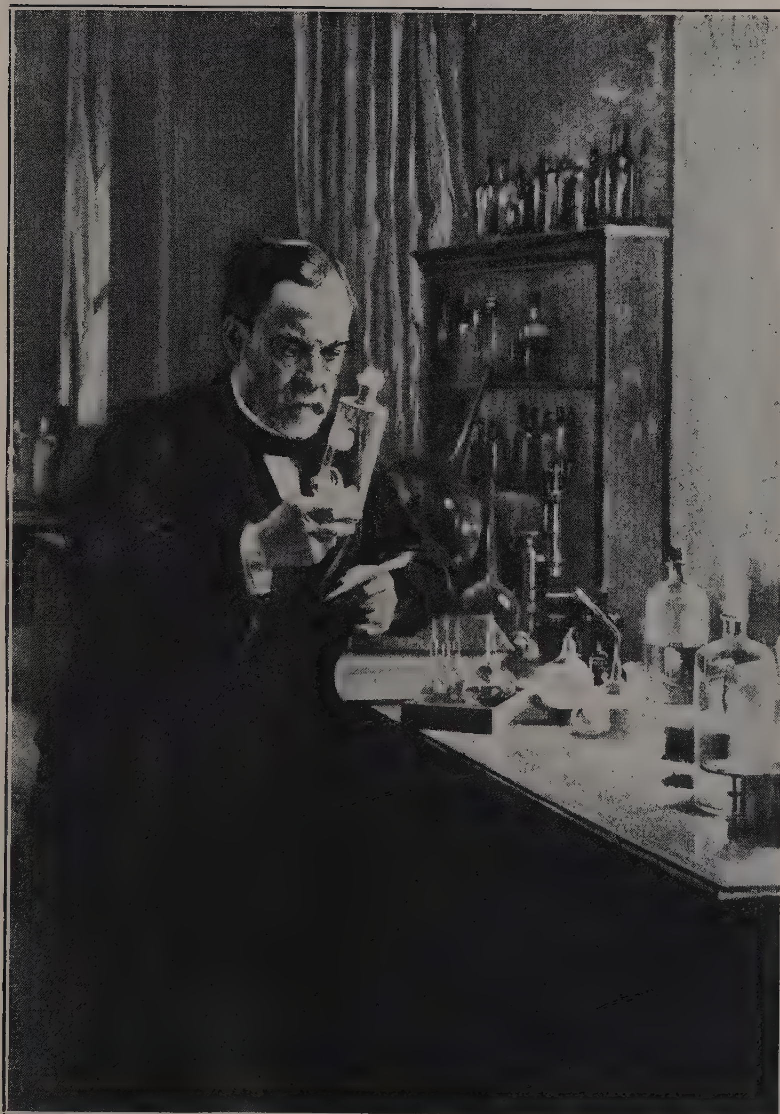
This was the dawn, let us now look at the sunrise.

IV

PASTEUR

This man Pasteur deserves an entire chapter in the story of health, because he was the author of the most momentous chapters in its history. Of all the many notable actors in the drama constructed about the conquest of disease, he is the most illustrious. For a generation he played the stellar rôle at a time when many brilliant players were contesting for the leading part. It was he who converted the perennial tragedy of disease into the beguiling melodrama of health. It was he who made of public health a science, and that is an achievement which has done more for humanity than all the exploits of that other fairly well-known Frenchman named Napoleon.

Adventure is blended with scientific attainment in the career of this chemist who created preventive medicine; romance is not lacking in the events of this bacteriologist, who, during the tempestuous span of his three score and thirteen years of life, laid the basis for all of modern public health work. Science is, after all, a glorious adventure, and the application of science to the welfare of humanity is one long romance. The episodes woven about D'Artagnan or Monte Cristo are no more entertaining than the scientific crystal gazing of Pasteur, his ventures with the magic flasks, his efforts to save the Trees of Gold, or his battles with anthrax and rabies.



From a painting by A. Edelfelt

LOUIS PASTEUR

WHO WAS HE?

This man, who was one day to associate with emperors and the far more important potentates of science, came from the usual humble and obscure environment, which seems to be characteristic of many future celebrities. He was the son of a tanner of Dole, a tanner, however, who had been sergeant-major in the army of Napoleon the First, a veteran who wore the red ribbon of the Legion of Honor. The son, Louis, was born in Dole on December 22, 1822. His early life, again like that of many of the great of the world, was uneventful and only that of any average French school boy. During this period the elder Pasteur moved from Dole to Marnoz and thence to Arbois, where Louis attended the Ecole Primaire and later the Arbois College, in neither of which did he distinguish himself. When he was sixteen he was sent off to Paris to prepare himself for the Ecole Normale, but immediately on his arrival, he contracted the disease known as nostalgia and a month later this homesickness had driven him back to Arbois and the familiar smell of the tannery.

Young Pasteur's tastes went to colored chalks and artists' materials, but Destiny did not have the career of an artist in store for him. Instead, it sent him off to the nearby college at Besançon to study philosophy. After a few years he found himself headed once more for the Ecole Normale in Paris, where he was enrolled in 1842. Then Fate stepped in. Although physics had interested him at first and he had won several prizes in this subject, it was chemistry which finally lured him, and it performed the feat in that mysterious manner which is the wont of Fate.

One day Louis Pasteur went to the Sorbonne to attend a lecture by M. Dumas, the celebrated successor of the famous Gay-Lussac. He came as a casual listener, but as the wonders and glamours of that science which is the daughter of alchemy unfolded before him, he sat enthralled. This was the turning point of his life, he would be a chemist. He became one, but more than that he was the disciple of M. Dumas. Chemistry was only a science treating of atoms and their relationships, but Dumas was a man, and it takes a teacher to interpret the soulless facts of science and enthuse the brain of man with their reality and significance. M. Dumas taught well and M. Pasteur was an apt pupil.

PASTEUR THE CHEMIST

A few years later the researches of this tanner's son had become the topic of discussion in the Institute of France itself. Old Balard talked about him to Dumas, and Biot, another of the great academicians, expressed a desire to investigate the results of this young man, who had already overcome difficulties which had proved insurmountable for some of the greatest chemists. For Pasteur, working on tartaric acid, had discovered that there were two distinct acids instead of only one as every one had taught.

The crystals of the one acid rotated light to the right, those of the other rotated it to the left. When Pasteur had ascertained this fact one day in his laboratory he rushed out, eureka-like, exclaiming "I have it," and seized a passing instructor whom he dragged out into the Luxembourg gardens to tell this somewhat bored and unwilling listener, who was a stranger to him, all about his wonderful discovery. Biot himself verified

the result and from then on took Pasteur under his wing.

Shortly thereafter Pasteur received a professorship at Dijon, but after a short period moved on to Strasbourg. There on May 29, 1849, he married Marie Laurent, daughter of the Rector of the Academy. He told her, and she acquiesced in it, that his laboratory must take precedence over everything else, for both knew that the researches of the young chemist, then only twenty-six years old, would some day bring fame to the Pasteurs. They did. In the next few years he perfected his studies on crystals and won acclaim and prizes on all sides. Then in 1854 he was made professor and dean of the new Faculty of Sciences at Lille, a town which was the industrial centre of northern France. The next few years saw the laying of the foundation for the germ theory of disease.

FROM CRYSTALS TO MICROBES

Pasteur was popular at Lille. His classes were crowded and his students enthusiastic. Besides, he made himself useful to the industrial leaders who were, incidentally, supporting the university. One day the father of one of his pupils, Monsieur Bigo, came to him in considerable distress. He was having trouble with the fermentation of his beet sugar into alcohol. Would not the dean help him? The dean then knew nothing about beets and not much about alcohol, but he would be pleased to be of service. His subsequent investigation was the starting point for a new theory of fermentation, a theory which rudely but authoritatively shattered the existing notions, based on the ideas of no less important persons in the chemical world than Messrs.

Berzelius of Sweden and Liebig of Germany. These gentlemen asserted that fermentation was due to contact between elements or by decomposition which ruptured the elements. Pasteur said that fermentation was due to living organisms, visible only under the microscope, and he proceeded to prove it.

Just at this stage of his career, two tragedies crept into the life of the great chemist. The first did not matter, for it was temporary, but the second was permanent. He went to Paris and stood for election to the Academy but was decisively beaten. The Academy was later glad to remedy this mistake. In 1859 the man who was to demonstrate to the world how to rid itself of many communicable diseases lost his oldest daughter from typhoid fever.

In 1858 Pasteur had returned to the Ecole Normale, this time as director of scientific studies. Among other duties he had "the surveillance of the economic and hygienic management, the care of general discipline, intercourse with the families of the pupils, and the literary or scientific establishments frequented by them." As an office and laboratory he was given two attics. There, with not a helper, he proceeded with his studies on fermentation, interspersed with the receipt of occasional prizes, such as that for experimental physiology conferred on him in 1860 by the Academy of Sciences.

PASTEUR AND THE MAGIC FLASKS

After a while Pasteur managed to acquire a laboratory, such as it was, and an assistant. The laboratory was a small building which had been constructed for the architect of the school. It was a queer place and he

could reach his drying stove only by crawling on his knees under a staircase. But what great achievements were to come from that dingy laboratory, which was even darker and mustier and murkier than some of the decrepit old shanties in which a few of our medical schools have been housed almost up to modern times.

It was in his laboratory at the Ecole Normale that Pasteur began to tinker with flasks, flasks which are now the most prized possessions of several medical museums. In them he placed a nutrient liquid and then drew air into them. The result was that germs grew and multiplied, germs which he watched avidly with his microscope. He found that the air of his cellar did not cause alteration of the liquid in his flasks, but that air from the yard did. From this he concluded that dust was full of these germs. Not yet, of course, was he thinking of these organisms in connection with diseases, but only for their influence on fermentation.

These invisible creatures which Pasteur called germs, had been discovered long before he was born. Anthony Leeuwenhock of Delft, who invented the microscope in the latter part of the seventeenth century, had seen them, and the Italian Abbe Spallanzani had studied them in the middle of the eighteenth. This latter scientist had had a terrific contest with a fellow priest, the Abbe Needham of England, who upheld the doctrine of spontaneous generation, that is, claimed that the germs would develop spontaneously in any suitable media. Spallanzani showed that the Reverend Needham was wrong. A hundred years later Pasteur demonstrated the same thing with much more refinement and precision.

He took his famous flasks to Arbois and opened them among the vineyards. Then he took them up on the

mountains and discovered, as he expected, that the pure air of the Alps yielded no germs. This fact was controverted by a fellow scientist named Pouchet, who had been playing with flasks, too, and who claimed that the microzoa, as he called them, were born in the nutriment and did not come in on the air. Most people inclined to his view. Pouchet himself, with two companions, ascended a mountain, and drew air into flasks filled with a decoction of hay. Triumphantly, they found that organisms grew, though they did not know the true reason. It was, of course, because of bacteria hidden in the crevices of the hay. At any rate, Pasteur challenged his opponent to a duel of scientific demonstration, to be staged before a commission of the Academy.

The contest was to have occurred in March, but Pouchet and his friends had it postponed until summer. In the meantime, Pasteur was giving popular lectures at the Sorbonne to audiences which included Alexander Dumas, Princess Matilde, and George Sand. Finally, Pouchet said he was ready, and Pasteur, having always been ready, was willing to oblige, when Pouchet attempted to dictate various terms to the commission, which they refused, though he had chosen the members himself. The result was that the demonstration never was held and the public proceeded to espouse one side or the other. A merry controversy ensued, which was, however, interrupted by a new venture on the part of Pasteur, an episode which took him somewhat farther along the road which was to lead to the conquest of disease.

HELP FOR THE TREE OF GOLD

Pasteur went to save the silkworms at the behest of his old friend and teacher, Professor Dumas. A mys-

terious disease had been wreaking havoc with the silkworms in the south of France since 1849, and also in other parts of the world, except in Japan, which was the only place where the healthy seed could be obtained. The distressed owners of the Trees of Gold, as the mulberry was called, turned to Pasteur in 1865. So he went to Alais, where he found universal discouragement among the nurserymen and the conviction that nothing would rid the silkworms of their *pebrine,* or pepper spots. Pasteur thought otherwise, though he did no boasting, but began to experiment. His studies were interrupted by the sudden death of his father and this sad event was followed within a few months by the demise of his little two-year-old daughter, Camille. In spite of his great grief, Pasteur went back to his work. He had examined hundreds of moths and other forms of the silkworm under his microscope and had conducted breeding experiments with diseased and healthy species. He came to the conclusion that every moth containing corpuscles would produce diseased seed. He would have to wait until spring when the worms were hatched, in order to follow up his experiments, so had returned to Paris.

For a while he and Claude Bernard, the great physiologist, worked on a study of cholera, but unfortunately got nowhere. Then Pasteur was invited to visit the emperor, Napoleon III, who was much impressed by him. But the scientist was anxious to return to his silkworms and back he went early in 1866. He had hardly plunged into his work when another tragedy occurred, again the loss of a loved one from disease. His daughter, Cecile, then twelve years old, died of typhoid fever. Think of it, two of the children of the man who was to banish

many of the contagious diseases, died of such a malady as typhoid, a disease now almost non-existent in our country.

On top of this came failure. Pasteur had told the nurserymen of Alais to examine the moths under the microscope and discard the eggs of all those who showed corpuscles under the skin. For, he said, if the corpuscles are not there, the eggs are sound and will produce healthy worms. When spring came, his confident prophecy turned out all wrong. The presumably healthy eggs hatched out sick worms just as had the others. Pasteur was almost in disgrace and the silkworm industry nearly lost faith in him, but he persisted in his investigations and finally he and his assistant, Gernez, discovered the real key to the situation.

They fed healthy worms on clean mulberry leaves and found, as expected, that the worms prospered. Then they fed these worms on leaves smeared with the discharges of sick worms and discovered that they got sick. The experimenters crushed sick worms and fed them to well ones and saw the disease spread that way. They examined these corpuscles under the microscope and finally, after many months, they made a startling discovery. The corpuscles were not the result, but the cause of the disease. They were living germs, which inhabited the entire body of the moth. The error had been in examining a part only, when the whole moth should have been ground up and then examined. This new theory was put to the practical test and was successful. The silkworm disease called pebrine was solved and it remained only to apply the facts.

Pasteur returned to his studies on wine. In 1868, at the age of forty-five, he was suddenly stricken with a

cerebral hemorrhage, from which he nearly died, and which left him permanently crippled, with his left side paralyzed. He had not been expected to recover, and work on a new laboratory, which was to have been erected for him at the Ecole Normale, was abruptly ceased. When Pasteur heard of this, he decided that nothing would prevent his recovery, and Napoleon, having also learned of the event, ordered the work resumed. During his convalescence, Pasteur perused an English book called "Self Help" by an author appropriately named Smiles. As soon as he had recovered sufficiently, he went back to the silkworms, which, saved from pebrine, were having other troubles. Each disease of the worms which he tackled was vanquished, though it took several years to do it.

FROM SILKWORM DISEASE TO HUMAN MALADIES

During the war of 1870, Pasteur's son served in the French army, where the father would have liked to have been, but there was no place for the partially paralyzed. He assuaged his patriotic feelings somewhat by sending back to the University of Bonn the honorary diploma of doctor of medicine, which that German university had conferred on him in 1868. After a heartbreaking expedition in search of his son in the retreat of General Bourbaki's Eastern Army Corps, a quest which was fortunately successful, he turned to studies on beer in an attempt to make French beer superior to German. He also studied vinegar and these various researches convinced him that the problem of human disease was likewise one of germs.

Not many scientific people were in agreement with Pasteur at this time on the subject of micro-organisms

and their effects. His old enemy Pouchet published a book on the infinitely small, but forebore to mention the great chemist, and Liebig took occasion to dispute Pasteur's findings. Another formidable opponent was M. Fremy of the Academy of Sciences, who criticised M. Pasteur and asserted somewhat recklessly that he had studied fermentation at a time when his learned colleague, Pasteur, was barely entering into science. The latter thereupon set out to demolish the theories of M. Fremy, who claimed that the grape was induced to ferment by yeasts contained under its skin.

"Would M. Fremy confess his error," stormed Pasteur, "if I were to demonstrate to him that the natural juices of the grape, exposed to the contact of the air, deprived of the germs, can neither ferment nor give birth to organized yeast?" He proceeded to demonstrate, although those of his colleagues who were for him, like old Balard, advised him not to waste his time on his adversaries. He took some of his flasks, filled them partially with grape juice, drew out the necks in small points, then boiled the contents. No fermentation occurred during ensuing days and weeks. But when he inserted in the flasks wash water from other grapes, water in which he had observed germs under his microscope, fermentation resulted in a few days. As a control, he boiled some of this wash water before inserting it and no fermentation took place. Thus it was shown that ferments were living things which had to be introduced from without and could not be born spontaneously. This experiment ought to have finished Fremy, but the lively row continued, for man thrives on opposition.

"Pasteur," writes his biographer, M. Valery-Radot, "had glimpses of another world beyond the phenomena

of fermentation—the world of the virus ferments." In 1873 he was elected to the Academy of Medicine, in spite of the distrust against chemists felt by most of the medical profession. Vindication for the place of this particular chemist in the field of medicine came shortly thereafter, however, from no less a person than the distinguished British surgeon, Joseph Lister, who had introduced antiseptic methods of surgery into English hospitals as a result of the germ theory so ably elucidated by Pasteur. Lister's letter was greatly appreciated by its recipient, who reproduced it in many of his scientific papers and even went so far as to include it in his book on beer. He also ran for the Senate, but was decisively defeated, for scientists were no more welcome in political bodies then than they are now. So Pasteur went back to his laboratory and the next few years saw the beginning of epoch-making achievements in the victories over disease.

THE ATTACK ON ANTHRAX

In 1877 Pasteur turned his attention to splenic fever, also called charbon, and now generally known as anthrax. This disease of cattle, which was also communicable to man, with invariable fatality, had been causing great havoc in the agricultural districts, especially among sheep. A somewhat obscure German physician, Dr. Robert Koch, had already been making studies on this malady, investigations which were to raise him from imperspicuity to fame. Dr. Koch was, in fact, as much the founder of the science of bacteriology as was Pasteur. In 1876, at the age of 34, he discovered the specific organism which caused anthrax. He grew the spores of this microbe and found that they caused

the disease when inoculated into animals. Later, in 1882, he discovered the bacillus of tuberculosis, and did many other marvellous things in the field of bacteriology. He was, moreover, the only really great rival who tipped lances against Pasteur.

About this time the term "microbe" was invented to characterize all the infinitely small organisms. The word was suggested by a Dr. Sedillot, a famous physician, in a paper which he read in 1878 before the Academy on the subject of Pasteur's influence on medicine and surgery. The latter scientist promptly adopted the word and soon made the whole world familiar with it. In these endeavors he was ably assisted by a brilliant pupil, a young medical graduate named Emile Roux, who with M. Chamberland, had joined him as assistants.

Although Pasteur was worshipped by his helpers and revered by many others, there were numerous persons who seemed to get satisfaction from deriding him. A Dr. Colin took exception to everything that Pasteur said and did. When Pasteur declared that hens were not subject to anthrax, Colin promptly asserted that they were, so Pasteur challenged him to produce a hen dead of anthrax. Colin promised that he would but he never did. Pasteur had observed that the body temperature of hens was higher than that of humans, to which he attributed their immunity to this disease. In order to ascertain the effects of a lower temperature, he immersed his hens in cold water and discovered that they became susceptible to and died of charbon. This ingenious experiment revealed much, moreover, for it showed that the lowering of bodily resistance allowed a greater onslaught by the germs of disease. Pasteur

repeated his experiments for the benefit of the Academy and finally even convinced M. Colin himself.

Not only did studies on anthrax occupy the time of the great chemist, but other investigations were conducted simultaneously, particularly on wines. Pasteur was a man of vision, besides, for he foresaw the day when all microbic diseases would yield to the efforts of man. "Is it not permissible to believe," he asked, "that a day will come when easily applied preventive measures will arrest those scourges which suddenly desolate and terrify populations?" We know the answer now; it is yes. Then Pasteur turned his attention for a while to puerperal, or child bed, fever, which had already been proven by the Austrian Semelweis to be contagious. Despite this work, child bearing had continued to be a most hazardous event, and lying-in hospitals were literally morgues as often as anything else. Pasteur did not hesitate to speak his mind on the subject and one day even had the temerity to interrupt rudely a learned doctor at the Academy of Medicine and declare that physicians themselves carried the germ of this disease from one patient to another. When the astounded orator remarked sarcastically that this particular germ would never be found, Pasteur limped to the blackboard and drew its picture.

THE LUCKY DISCOVERY

Pasteur and Chamberland and Roux were now experimenting with all kinds of diseases, one of which was chicken cholera, often the cause of disastrous farmyard epidemics. Pasteur isolated the microbe of this disease and made cultures of it, which, when injected into healthy birds, promptly caused death. By

accident some of these cultures were put aside and forgotten for a considerable time. One day these old cultures were brought out and injected into some hens. The birds sickened, but did not die. Some months after their recovery, these same hens were inoculated with virulent cultures. Instead of dying, the birds showed resistance to the disease.

Here was a most interesting phenomenon; attenuated cultures produced an immunity against the full dose of the disease. The thought staggered Pasteur. Had he stumbled upon a method of vaccination which would rival, which might even prove superior to the classic discovery of Dr. Jenner? He proceeded to apply the process to anthrax and after many attempts, with the faithful aid of Roux and Chamberland, a vaccine was evolved. During all this time he indulged in numerous controversies with his scientific colleagues, particularly those of the medical profession, who did not hesitate to leap to the fray with ardor. They considered Pasteur arrogant, nor did he hesitate to treat them with a contempt, which in some cases was not entirely unmerited.

Not only did this master of preventive medicine antagonize the august members of the medical profession but he offended the veterinarians, who were naturally much concerned about such an important animal disease as anthrax. The editor of the leading veterinary journal ironically called Pasteur "the pontiff of microbiolatry" and proposed that this prophet of the germ put his theories to a practical test. It was a trick to quell Pasteur, but that individual shrank no whit from any such challenge. He was eager, in fact, and the results proved once and for all who was the ruler of the microbe.

THE GRAND EXPERIMENT

The Agricultural Society at Melun put sixty sheep at the disposal of Pasteur. Twenty-five were to be vaccinated, then these and twenty-five unvaccinated sheep were to be inoculated with anthrax. The remaining ten were the controls. "The twenty-five unvaccinated sheep will all perish," said Pasteur confidently, "and the twenty-five vaccinated ones will survive," and he assured his somewhat nervous assistants that what held good in the laboratory would prove successful at Melun. This was the supreme test from which there was no retreat.

On May 5, 1881, the vicinity of Melun took on a gala appearance. Senators mixed with farmers, physicians and veterinary surgeons crowded together, and all walks of life assembled at the Pouilly le Fort farm, where the first act of the great drama was to occur. At the last moment two goats, nine cows, and an ox were substituted for several of the sheep. Pasteur arrived amidst applause, tempered with some derision, and, with Roux, Chamberland, and another pupil named Thuillier, went to work. The twenty-five sheep, five cows, and the ox were deftly vaccinated. This done, Pasteur lectured for an hour or more and the day's show was over.

Twelve days later, a second inoculation was given. Finally, on May 31st, all the sheep, vaccinated and unvaccinated, were shot full of virulent anthrax bacilli. The spectators, believers and unbelievers, were to come back on June 2nd and witness the results. On that day Pasteur received a telegram from M. Rossignol, the umpire of the demonstration. It ended with the words,

"stunning success." When Pasteur went back to Pouilly le Fort, he was greeted with great acclamation by the vast crowd, including delegates from all sorts of interested societies, farmers, officials, and journalists, for he had triumphed completely.

There before him lay the carcasses of twenty-two unvaccinated sheep, while two others were dying. Every one of the vaccinated animals was in perfect health. They changed the name of the farm to Clos Pasteur and shortly thereafter the Republic pinned on his breast the Grand Cross of the Legion of Honor, only, however, when at his request Roux and Chamberland had also been awarded the celebrated red ribbon. He was invited to an International Medical Congress in London, where he was received with great acclaim and invited to lunch by the Prince of Wales. His opponents ceased their attacks for a while, but only for a while, for even after he had been elected to the Académie Française and had become one of the forty immortals, his scientific and intellectual enemies returned to the fray.

Dr. Koch in Berlin and his pupils apparently never hesitated to criticize Pasteur adversely and the latter never was backward in giving as good as was sent. Koch, moreover, was a more meticulous scientist than was Pasteur and his tests showed that the anthrax vaccine was often impure and contaminated by other bacteria. Regardless of these flaws, the principle discovered and applied by Pasteur was of tremendous importance, for it was the foundation of the whole modern campaign against the communicable diseases. Dr. Koch, having made some contributions to science himself, was inclined to display a Teutonic arrogance in being unable to give credit to others.

THE MAD DOG

Since 1880 Pasteur had been concerned about one dreadful disease which was invariably fatal to man. This was rabies, or hydrophobia. As a boy Pasteur had, in 1831, witnessed the ravages of this awful malady in Arbois where eight persons died as the result of bites from a mad wolf, which had charged, howling and with foaming mouth, through the streets of the village. The scene and its hateful aftermath made a vivid and undying impression on the nine-year-old boy. When, therefore, an old army veterinary surgeon came to him half a century later with two mad dogs, Pasteur began those brilliant studies which culminated in what is now called the Pasteur treatment for rabies.

The research on hydrophobia was carried amidst other investigations. Cholera in Egypt demanded attention in 1883, and Pasteur sent Roux and Thuillier to the battle against this disease. In a few months, Louis Thuillier was dead of cholera. Dr. Koch, who was also in Egypt for the same purpose as his French colleagues, reverently laid on the coffin of this young martyr to science a wreath of laurel, "such," he said, "as are given to the brave." Later Koch, regardless of his own personal danger, isolated the cholera microbe, which he called the comma bacillus, on account of its peculiar shape.

Meanwhile Pasteur was beginning to make headway against hydrophobia. He, too, constantly exposed himself to a horrible death, that from rabies, for he collected saliva from the foaming mouths of savage bull dogs, while assistants held the struggling animals. He discovered, however, that it was the brain which

was the principal seat of the germ of the disease. Roux had deftly trephined the skull of a dog, disregarding the protest of Pasteur, who was loathe to harm any animal. The brain of the dog was inoculated with fresh virus and it died shortly afterwards from rabies.

The problem, of course, was to produce an attenuated strain of this virus. In a way Pasteur was working in the dark, for he had never been able to isolate the rabies microbe and see it under the microscope. For that matter, it never has been seen, even to this day, for it is evidently one of those filtrable viruses, which are too small for the eye of the instrument. Rabies is diagnosed by the presence in the brain of the rabid animals of organisms known as negri bodies, which are always concomitants of the disease, though probably not its cause. Pasteur knew that there was a germ of rabies because of the effects he could produce by rabid material.

A method of weakening the virus was finally discovered. A portion of the spinal cord of a rabbit which had died of rabies was dried and when used to inoculate dogs, this attenuated strain did not kill, but produced immunity. These experiments were carefully tested by a commission of scientists, which confirmed them in every particular. Even the Emperor of Brazil got interested in the subject and wrote to Pasteur about it.

THE GREATEST TEST OF ALL

Many dogs were inoculated with the new rabies vaccine, which was as successful in its results as the anthrax vaccinations had been several years before. Pasteur had never vaccinated a human being and on account

of his gentle nature, no doubt shuddered at the very thought, in spite of the unquestionable benefits which would accrue from such an operation. Then, there suddenly came the necessity for the greatest test of his career.

On July 6, 1885, a frantic Alsatian mother entered Pasteur's laboratory with a nine-year-old boy, Joseph Meister, who had been attacked by a mad dog. The infuriated animal had assaulted the boy while he was alone on the way to school, and before assistance could arrive, had inflicted fourteen painful wounds. After the dog had been beaten off, it rushed back to its master and bit him on the arm. The parents hastened their boy to a physician, Dr. Weber, who cauterized the wounds, and advised that M. Pasteur be consulted at once.

Although Pasteur had not dared before to use his vaccine on mankind, humanity demanded that he give succor to this boy, whose parents and physician were willing to trust to his skill and knowledge. Pasteur consulted two eminent physicians, M. Vulpian and M. Grancher, who had been following his experiments and who had even worked at his laboratory. They advised that the tests on dogs had been sufficiently conclusive to authorize the operation on the boy. The two doctors examined Joseph and decided that no time should be lost.

An attenuated virus was chosen, one fourteen days old, and a few drops were injected into the boy. More virulent substance was given the following day and so on for each day, until fourteen had been injected in all. These were anxious moments for Pasteur, but he knew there was no drawing back now and he wrote to a

friend "perhaps one of the great medical facts of the century is going to take place." He was right. Joseph Meister went back to Alsace cured of his wounds and with no sign of the dreaded hydrophobia. Pasteur's first human inoculation was a success.

IN THE SERVICE OF HUMANITY

The great scientist took a brief vacation after this triumph, but when he returned to Paris he was besieged by a legion of persons who had been bitten by rabid dogs. A vaccination service was established to treat the innumerable patients who flocked to the laboratory—most of the treatments were successful, though one patient who was brought in thirty-seven days after having been bitten could not be saved. Four children were even sent all the way from New York, accompanied by another scientist who was eventually to be eminent, Dr. Hermann M. Biggs. The children were from the working class and their journey was made possible by means of a public subscription raised by the New York *Herald*. Notwithstanding the time which had elapsed, they were successfully inoculated and were received with great enthusiasm on their return to America.

Then came nineteen peasants all the way from Russia. They had been bitten by a mad wolf in Smolensk and had suffered terrible wounds. Because of the gravity of the situation, two inoculations were given each day. Three of the victims died, but sixteen recovered. Valery-Radot tells that "Pasteur" was the one French word known to these poor mujiks, and that one word must have held out to them all the hope and brightness in the world. Some time later there came to Pasteur

another thing from Russia; it was the cross of St. Anne, set in diamonds, and the gift of the Tsar himself.

In gratitude for the tremendous benefits conferred on humanity by the humble chemist, the whole world united in raising funds for a Pasteur Institute in Paris. Every country and every walk of life in every nation was represented in the subscription lists. The Institute is still there in Paris and continues to bear the illustrious name, though the eminent benefactor of all the world has joined his forebears in their eternal sleep these thirty or more years ago. The Institute was opened on November 14, 1888, by the President of France, M. Carnot, in the presence of a distinguished assembly.

The Pasteur Institute at Paris now consists of a hospital, two large laboratory buildings, and a farm where the necessary large animals are kept. Serums and vaccines are manufactured by the Institute and research is undertaken. The investigations cover the entire field of biology and many noteworthy additions to the science of preventive medicine have come from this laboratory which bears the greatest name in the history of public health.

VIVE PASTEUR!

When the Institute was opened, Pasteur was in the sunset of life. He was then sixty-six years old, but his labors continued for several years, though of necessity the burden was transferred to his faithful pupils, Roux, Chamberland, and others, now scientists in their own right. On December 27, 1892, a great celebration was held in the theatre of the Sorbonne, in honor of Pasteur's seventieth birthday. Delegates came from many

lands to greet the master, who entered on the arm of the President of the Republic. Lister, whom Pasteur embraced publicly, brought him the homage of medicine and surgery. Pasteur's reply was read by his son, as the age of the great chemist and his emotion rendered his voice inarticulate.

Satisfying as was this tribute, a greater triumph was in store. This was the conquest of diphtheria by Roux, which was announced from the Pasteur Institute in 1894. The germ of diphtheria had been discovered in 1883 by a German named Klebs and had later been isolated by Loeffler, another German, for which reason it is to-day called the Klebs-Loeffler bacillus. Roux and a co-worker, Yersin, developed the anti-toxin which would combat the toxin produced by the bacillus. This was accomplished by inoculating a horse with the toxin, so that there was formed in the blood of this animal a substance which attacked the toxin. Thus, the serum from the blood of the horse yielded the anti-toxin, which could be used in the cure and prevention of diphtheria in humans. This discovery meant that another frequently fatal disease had been vanquished, or at least, that the methods for victory over it had been made available.

To-day, further developments have made diphtheria a disease the existence of which is inexcusable. A method of vaccination has been perfected, using a mixture of toxin and anti-toxin which confers a complete immunity, just as powerful as that bestowed by the vaccination for smallpox. Every child under ten years of age should be vaccinated against diphtheria as a matter of routine and when this is done, the disease will disappear.

Other great discoveries came from the Institute during the waning years of Pasteur's life. Also in 1894, M. Yersin discovered the bacillus which causes bubonic plague. A great Russian scientist, Metchnikoff, had come to the Institute and there announced his theory of immunity, called phagocytosis. This was the golden age of bacteriology, for the microbic causes of many diseases were recognized in the two decades at the end of the nineteenth century. Unfortunately, Pasteur did not live to witness all of these vast achievements.

Surrounded by his family and his friends, Pasteur died on September 28, 1895, after an illness of nearly a year. A few months before his death he had been carried into his beloved laboratory, where Roux had arranged on tables the little flasks which Pasteur had used in his experiments to discredit spontaneous generation, and also the tubes he had employed in his wine studies and other investigations. He looked through the microscope at the newly discovered plague bacillus and received reports of the endeavors of his pupils and disciples.

The influence of the Institute was then world wide. Even as Pasteur was going to his laboratory for the last time, Yersin was working in China, Nicolle had just set up a laboratory in Constantinople, Calmette was opening a branch at Lille, others were engaged in Brazil, Australia, Tunis, and elsewhere. And Pasteur, whose life had been one of activity and achievement, looked across the orderly room at his friend, Roux, standing there in the fading light of a summer evening. "Much has been done," said Pasteur softly and a little wistfully, "but there is still a great deal to do."

V

THE LADY WITH A LAMP

The most ancient profession for women is the honorable art of nursing and not that much less creditable one which is sometimes alleged. The light that glows for the ladies with the lamp is golden and not red. Unwarranted aspersions are cast on womankind by those careless writers who make the crass assertion that the trade associated with the primrose path is the oldest of professions. Social sensuality did not really commence until that late period when society became organized, but ministration for the sick began with the first occurrence of disease, and that regrettable event happened at least half a million years ago, with old Pithecanthropus Erectus and the Dawn Man as the unfortunate subjects.

PHEBE AND HER FOLLOWERS

A Lady With A Lamp nursed St. Paul, who said of the gentle Phebe, "She hath been a succourer of many and of myself also." Another of these ladies was St. Chrysostom's helper in the early days of the Christian Church, while yet another built the first public hospital in Rome. Some of these nurses of ancient times, these ladies of the lamp, were wives or daughters of kings and emperors, some were peasant-born, but all were actuated by the ideal of service to suffering humanity. History, as written, contains too much about those who were prone to destroy and not enough concerning those who have nourished and nurtured and nursed the race.

It was The Lady With A Lamp, you will remember, who really saved the day after Balaclava. By her skillful and much needed care of the wounded of the valiant brigades who thundered into history on the fields of the Crimea in 1854, Florence Nightingale well earned this apt title conferred upon her by a poetical admirer. In 1857 Henry Wadsworth Longfellow published his fervid, if none too lyrical, ode to Santa Filomena, saying

> "A Lady with a Lamp shall stand
> In the great history of the land,
> A noble type of good
> Heroic womanhood."

The inspiration for this famous poem came from the actual practice of the celebrated nurse in making her rounds at night carrying a lantern which she set down as she ministered to her patients. As she moved sedately (not "flitted," as Mr. Longfellow has it) through the fever-haunted wards, the stricken soldiers would often turn to kiss

> "Her shadow as it falls
> Upon the darkening walls."

Long before Florence Nightingale came with her lamp to found the modern system of nursing, the art of caring for the sick and afflicted had been cultivated by many men and more women who had consecrated their lives to this sublime activity. As soon as sickness appeared among human beings, even when the first vestiges of human attributes were manifest in our shaggy ancestors, there were undoubtedly some who would care for the brutes. Not until a few centuries before Christ, however, are there any definite records

of nursing. These are not to be found in ancient Egypt, as might be expected, but in the oldest Hindoo books.

In these records are many details of ancient nursing. One writer, Charaka by name, even gives specifications for a good nurse. "Knowledge of the manner," he says, "in which drugs should be prepared or compounded for administration, cleverness, devotedness to the patient waited upon, and purity (both of mind and body) are the four qualities of the attending nurse." Not bad counsel for 300 B. C. and better in its consummation than some modern patients seem to get.

The Sacred Books of Ceylon tell us that two kings with the somewhat euphonious names of Dootoogameny and Parackramabahoo built hospitals several hundred years before Christ. Whether these edifices were staffed with nurses is not stated, but it seems likely. In India King Asoka erected a stately hospital about the same time, but the great advances in hospitalization came in the early Christian era. In its beginning, as now, the Church endeavored to care for the body as well as the soul.

Members of the modern orders of deaconesses, and those who have been privileged to receive nursing attention at the hands of these spiritually-minded women, will be interested to know that the first deaconess, or diakonus, was the Roman nurse, Phebe, who was the contemporary of St. Paul. The deaconesses of the early Christian era consisted of both men and women who were ordained by the Church. Their sole mission was to attend the sick, and the order spread rapidly, reaching its height in the fifth century when Olympia, wealthy wife of the prefect of Constantinople, served as archdeaconess under the direction of St. Chrysostom. Al-

though characterized as noble, sweet, and rich, it has been said of Olympia by one of her contemporaries that she "abstained from animal food, and went for the most part unwashed." The former trait may not have injured her ability as a nurse, but the latter certainly did not improve it.

Inasmuch as the order of deaconesses was abolished by a church decree in 533 A. D., it declined in influence from then until the eighth century, by which time most of the nurses were supplied by convents, although there was still a considerable number of male nurses. Prior to the fifth century, for instance, a corps of ruffians from Egypt and Syria, known as the parabolani, looked after the sick at Alexandria. Gibbons, the historian, classifies them as adventurers.

In 542 Childebert, son of Clovis, founded the famous Hotel-Dieu, or God's House, at Lyons, France, and in 650 the equally celebrated Hotel-Dieu of Paris was organized. These two hospitals are still in operation. In the earliest days of these institutions, the nurses were frequently recruited from fallen women who had repented. Since the seventeenth century, however, the nurses at Lyons have been sisters of religious orders, while the hospital at Paris has been served by the Augustinian sisters, the oldest purely nursing order of nuns in existence, created by Pope Innocent IV in the thirteenth century.

The first hospital in Britain was that of St. Peter and St. Leonard at York, established in 936 by Athelstane. Of the existing British hospitals, the most ancient is the renowned St. Bartholomew's, which was founded in 1123 by a profligate nobleman, Rahere, as a penitence for his follies. This courtier of Henry I

was said to have seen the vision of Saint Bartholomew while he lay ill of a fever in Rome. In gratitude for his recovery he gave the world a famous hospital. Many others have performed similar services, although too often after and not before they have themselves been cured of serious maladies.

In America the first hospital was that constructed by the grim Cortes in Mexico City in 1524. In the north, Jeanne Mance founded the Hotel-Dieu in Montreal in 1644, though a hospital had been set up in Quebec five years earlier.

SAINTS AND DAUGHTERS OF KINGS

As the centuries rolled by after the pioneering days of Phebe, nursing often became the vocation of noble persons who seemed to have more of a conception of altruism than have some of our more recent pleasure-loving potentates. Marcella, a high-born Roman matron, converted her palace on the Aventine into a nursing monastery, of which she was leader. Fabiola, one of her female disciples, built the first general hospital in Rome in 390 A. D. and thereby earned the high regard and praise of St. Jerome. Even the Empress Flaccilla, wife of Theodosius the Great, Roman emperor from 346 to 395 A. D., visited and nursed the sick.

During the Crusades, from the eleventh to the fourteenth centuries, many military orders were devoted to succoring the wounded and sick. Thus, the Knights Templar and the Hospitalers founded vast hospitals and in them and elsewhere nursed all who came for aid. One of the most famous of the woman nurses of the eleventh and twelfth centuries was Hildegarde, known as the Sibyl of the Rhine. Others of prominence were

the daughter of the king of Hungary, St. Elizabeth, who died in 1231 at the untimely age of twenty-four, after having been a mother at sixteen; and St. Catherine of Siena, a remarkable woman of peasant birth, who also died young, being only thirty-four at her demise in 1381.

In the Middle Ages, from the time when St. Francis of Assisi founded the Franciscan Brotherhood, in the thirteenth century, nursing was largely in the hands of secular bodies. Perhaps the most noted of these orders was that of the Sisters of Charity, founded by St. Vincent de Paul and Mlle. Le Gras in the seventeenth century (1634). This order first came to the United States in 1808 when a branch was placed at Emmettsburg, Maryland.

The dark period of nursing was from the latter part of the seventeenth century until the middle of the eighteenth, for skill and training were then seldom emphasized as requisites. The reform began in 1836 when a German clergyman, Pastor Fliedner, organized an order of Protestant deaconesses, whose motherhouse he erected in that year at Kaiserwerth on the Rhine. It was far from perfect, but it was a brave beginning, and it attracted international attention. In 1840 Mrs. Fry, the militant English Quaker lady, who had been vigorous in the movement for prison reform, visited Kaiserwerth and was so impressed that she returned to England and instigated the formation of a similar order. The Anglicans followed suit with their St. John's House in 1848.

And this brings us to The Lady With A Lamp, for Florence Nightingale was the most celebrated graduate, or perhaps it would be better to say, disciple of Pastor Fliedner's school, where she had been trained in 1851.

FLORENCE NIGHTINGALE

The British won the battle of Balaclava, as they did all of the great engagements of the War of the Crimea, from Alma to Sebastopol. But it was The Lady With A Lamp who took care of what was left of the valiant Light Brigade and of many other brigades which swept across these blood-stained fields in 1854. The soldiers who followed the banners of England and France hurled back the forces of the Tsar, but the cost was as terrible a one as Tennyson has depicted in his poem about the brave six hundred.

The cost was terrible and the British were unprepared to meet it. England had not fought for forty years when Lord Raglan was sent to help the Sultan against the Russians. As a consequence, nobody had thought to do anything about such trivialities as doctors and hospitals, or nurses and supplies. The reward for the desperate courage and dauntless bravery of the English soldier was neglect and inefficiency. "The manner in which the sick and wounded are treated is worthy of the savages of Dahomey," a horrified war correspondent wrote home to *The London Times*. This scathing report and others converted the patriotic exultation of the people into indignation and condemnation.

This was the situation when there arrived at Scutari a few days after Balaclava a Lady With A Lamp. The Lady was Florence Nightingale; the Lamp was a new and efficient system of nursing. It was a system so effective that it brought order out of chaos, in spite of the opposition of numerous old fogeys and innumerable miles of that army concomitant, red tape. It brought popular acclaim to the calm and somewhat imperious

lady, who for the next half century was to wield a potent influence on the hygiene of the nations.

The future mentor of the nursing profession was born at Florence on May 12, 1820, in the Villa Columbia near the Porta Romana. Her parents belonged to that wealthy Victorian class which divided its time in trivial social responsibilities between the house in London and the one or more houses in the country, with regular interludes of leisurely foreign travel. Florence and her older sister, Parthenope, born in 1819, were thus nurtured in this atmosphere of fascinating and useless existence, with nothing before them but dutiful matrimony and a continued life of ease and desuetude. Parthenope submitted to it gracefully and married Sir Harry Verney, who as a member of Parliament, was later of some assistance to Florence, who did not submit forever to being "the bird in the gilded cage." She was made of sterner stuff and it was lucky for the world that she was.

IDLER AND DREAMER

When Florence Nightingale landed at Scutari and shocked various military bureaucrats by bringing a bevy of female nurses, she was thirty-four years old. She had completely escaped from the gilded cage at last, but only after a long and at times tempestuous struggle. The perseverance and firmness which were always among her chief characteristics had aided her some half a dozen years previously to emerge from the dull routine of social life and embark upon a career of usefulness.

Her first attempt to be something more than an ornament in London and Lea Hurst was when she was

hardly out of her teens. Urged on by the restlessness of her spirit, she undertook to help as many sick persons as possible in the places where she lived during the different seasons of the year. Her more sentimental biographers have made much of a trifling event in which she meticulously bandaged the wounded paw of her dog.

The duties of caring for those who were sick and distressed had aroused her interest in nursing. When she was in her early twenties she suggested to her horrified parents that she actually study to be a nurse, a proposition which was promptly and emphatically vetoed by all concerned, except Florence. "It was as if I had wanted to be a kitchen maid," she said in later years in referring to this incident. Gentlewomen were not nurses in those days and nurses were not gentlewomen. Such a thing was unthinkable, unspeakable, and impossible.

One rebuff did not deter a woman like Florence Nightingale. For a while life seemed even more hopeless and ineffectual. The more restless she became, the more determined she was to do the thing which she considered worth doing. For a while she turned to religion, but even that did not seem to fill the void. By 1846 she was seriously pursuing studies of medical and sanitary subjects. A winter in Rome did not divert her and when she returned to London she proceeded to make tours of inspections of the dreary London hospitals. The more she became interested in the art of healing, the more her parents developed repugnance to such a "degrading" type of work.

FROM SANTA FILOMENA TO SAIRY GAMP

Florence Nightingale wanted to found a system of Protestant nursing sisters, an idea which was received coldly and without enthusiasm by her relatives and friends. When one visualizes the type of nurses who inflicted the early Victorian era, there was some justification for the abhorrence displayed by the senior Nightingales and their connections. Most of these nurses were illiterate, dirty, immoral, and drunken, and the average patient had a better chance to recover without being afflicted by one of these creatures than he did when required to submit to her clumsy ministrations. Nevertheless, the more Florence Nightingale heard of the bad features of nursing, the more she yearned to attempt to correct them.

The nurses turned out by the religious establishments were a trifle superior to the common group, but they were relatively few in number and most of the females who essayed to practise at nursing were of the type which Charles Dickens has so graphically described in his novel, "Martin Chuzzlewit." When Florence Nightingale thought of the many Sairy Gamps, she determined that this unsatisfactory system was overdue for a change. Thanks to her efforts, the reform was brought about in the course of time, for the obstacles only stimulated her to action.

FROM KAISERWERTH TO SCUTARI

When Miss Nightingale returned from her visit to Pastor Fliedner's Kaiserwerth in 1850, she wrote a pamphlet about this unique institution. Shortly thereafter she had an opportunity to marry, but she was con-

vinced now that there was a life work before her that would be hindered, if not completely spoiled, by matrimony, so she deliberately chose spinsterhood and a career. More foreign travel did not alter her purpose and in 1851 she returned to Kaiserwerth and took all of the training. Here she was happy at last, even though as she said the nursing did not amount to much and the hygiene was terrible. The spirit and inspiration were there, however, and her three months' sojourn with the gentle Fliedner and his deaconesses cured the restlessness which had been surging in her soul.

Having lived with these Lutheran sisters in Germany, Florence Nightingale desired to do the same among the Catholic sisters in France. With aid from Father Manning, who later became a cardinal, she actually went to France for the purpose, but a death in the family brought her home and when she got back to Paris, measles laid her low, so that her intentions were never carried out. Back in England Miss Nightingale now became superintendent of an "Establishment for Gentlewomen in Illness," a philanthropic organization on Upper Harley Street run by a large number of pestiferous committees. The lady of the lamp-to-be engaged the committees in mortal combat and brought order out of the chaos. In 1854 she tackled a cholera epidemic and nursed in the Middlesex Hospital. She wanted to be superintendent of nurses in King's Hospital, when the divine call came. It was for service in the Crimea.

When Miss Nightingale read the news despatches about the Battle of the Alma, she realized that the great moment had come for her. Just as she wrote to offer her services, Sir Sidney Herbert of the War Office was

writing to ask her to go. Their letters crossed. Miss Nightingale promptly, though with some difficulty, assembled a group of well-qualified female nurses, including ten Roman Catholic sisters, eight Anglican sisters, six from St. John's, and fourteen from various hospitals, and set out for Scutari. Her going was widely and favorably heralded and much interest was aroused in nursing. From a much-abused and scorned trade, nursing became almost a fashionable fad and all kinds of enthusiastic and often temperamentally unfitted ladies aspired to enter upon it.

THE CALL OF THE CRIMEA

Although Miss Nightingale considered her summons to the Crimea as her divine call, she well knew that she would not find a bed of roses there. Nor did she. After the Battle of the Alma, the Turks had turned over to the British a huge yellow barracks to be used as a hospital, one of four maintained at Scutari for the English soldiers. "The Nightingale," as she was dubbed by one of the colonels who had little use for such innovations as female nurses, was assigned to this barn-like structure, and her nurses were crammed into small uncomfortable quarters. Rats and vermin abounded and the stench was about as malevolent as that of the Thames on the historic occasion of the Great Stink of 1858. "A London hospital is a garden of flowers to it," wrote Miss Nightingale to a friend at home.

Sick and wounded heroes were crowded into this pest house and the other three, and covered with canvas sheets so coarse that injured men begged that they be spared such covering, preferring to risk the wind and rain which leaked into the rambling structure. Such

odious reports of the neglect and lack of equipment had reached London that a commission of inquiry had reached Scutari at the same time as the nurses. This committee promptly reported that the "state of the hospitals was disgraceful."

Into the correction of this mess The Lady With A Lamp threw herself with vigor. Fortunately, the people at home had raised a fund, entrusted to Mr. Macdonald of *The Times* for expenditure. Some time after Miss Nightingale had been at work, Mr. Macdonald turned over his money to her for a store, so that such necessities as soap, towels, basins, and other accoutrements of cleanliness might be provided for the patients. This radical step was taken in the face of the statement of the local British ambassador that nothing was needed and that the money could best be spent on the establishment of an English church at Pera.

RED BLOOD AND RED TAPE

The Lady With A Lamp served not only as a nurse and director of nurses in the Crimea, but as dietitian and purveyor. She was actually appointed Purveyor-Auxiliary to the hospitals, everybody else who had held this job having apparently failed at it. The official purveyor could seldom supply anything, because more than likely the needed supplies were safely packed under several tons of cannon balls, on a vessel en route to the battle front. Since Scutari was a way station, medical supplies actually did pass by in both directions in inaccessible places on shipboard, placed there with characteristic efficiency by officials back in London or at the front.

If Miss Nightingale had not possessed a strong con-

From "The History of Nursing," by Nutting and Dock. G. P. Putnam's Sons

THE LADY WITH A LAMP

tempt for red tape, she would not have accomplished as much as she did. If a soldier arrived at the hospital in clothes that as a matter of common decency had to be pried off him and burnt, he might have gone naked, as far as the army regulations were concerned. There was no regulation which provided for a new shirt and the Purveyor abided by regulations, not by humane considerations. As a consequence, Miss Nightingale furnished the British army with some 50,000 shirts. She supplied many other things, too, and but for her, numerous warriors would have gone hungry, dirty, or cold.

Rules were not willingly and deliberately broken by Miss Nightingale, except when emergency demanded. It is related that on one occasion, she found a dying patient in need of a hot-water bottle, which she requested an orderly to procure. He refused, because he had been definitely instructed to do nothing for a patient unless ordered by a medical officer. Since this was the rule, even though idiotic in its strict application, Miss Nightingale went off dutifully and hunted up one of the sacred personages who could, by making proper requisition, eventually get this article of comfort for the moribund patient. It is not recorded what Miss Nightingale remarked on this occasion, for, though invariably calm, she had a sharp and sardonic tongue. She was also gifted as a poignant letter writer and did not hesitate to inform Sir Sidney Herbert in the War Office what was what. Sir Sidney usually meekly acquiesced, but the red-tape-revering officials in the Crimea did not.

Although Queen Victoria herself became intensely interested in the work of The Lady With A Lamp and

lent her influence to her support, there were plenty of people on the ground who could not or would not co-operate. The worst offender was inept old Dr. Hall, the Principal Medical Officer, who if the record is to be believed, was more narrow and opinionated than the ambassador who wanted to spend money on altar cloths instead of towels and shirts. First he called Miss Nightingale's arrival "droll" and later he said her accomplishments were "twaddling nonsense." Backed by the powers at home, however, she fought this particular bulwark against progress and others who, as she said, would have preferred to have burned her at the stake like Joan of Arc.

Not only was there red tape to combat, but also intolerance. After the death of Lord Raglan, who had been a strong supporter of Miss Nightingale, there was some doubt on the part of those in authority as to her status. This was finally emphatically cleared up by a sharp note from the War Office, but only after a severe conflict into which racial and religious difficulties had entered. Without consulting Miss Nightingale, Dr. Hall assigned a number of Irish Catholic nursing sisters to a certain hospital. Miss Nightingale promptly issued different orders in the interests of efficiency and in the subsequent controversy which raged, the wrath of both popish and evangelical cohorts descended on her. She overcame all difficulties, nevertheless, and continued her services for the wounded, services which were thoroughly appreciated by the soldier and the public if not by some in immediate authority.

THE POPULAR HEROINE

Having beaten and discomfited Dr. Hall and other detractors at every step in the internal battles which, as is customary in most wars, rage among those who are supposed to be united in fighting the enemy, Miss Nightingale returned to England and fame. She was offered a warship to bring her home, but refused and came back as quietly as possible, eluding the bands and triumphal arches with which a grateful nation would have liked to greet her. Weary and worn from her labors which had continued several months after peace was signed in March of 1856, she escaped to the country for rest. The period of seclusion was not to be long, however, for there was more work to be done.

Throughout the remainder of her life Florence Nightingale was an invalid. For many years she was confined to her room, rarely going out, but always accomplishing a vast amount of work. She surrounded herself with a group of advisers, or to put it more accurately, assistants, who were eager to do her bidding and aid her. She called this group her cabinet and in it were included such persons as Dr. Sutherland, the sanitarian, and Dr. Farr, the statistician. Her brother-in-law, Sir Harry Verney, was at her beck and call, and her friend, Sir Sidney Herbert, was her faithful ally until his death in 1861. In spite of her delicate health, Miss Nightingale was always the dominating force which guided that cabinet.

This illness was sometimes most convenient. Basking in her glory, she made queens and princesses come to her, instead of going to them, and she saw only persons whom she chose and when she chose. The great of

the world did beat a path to her door, for a while, and she received many honors. In September, 1856, a year or two before she took to her bed, she had an interview with Queen Victoria, who was enchanted with her, and who promised to aid in her proposed reforms of the Army Medical Service.

HEALTH FOR TOMMY ATKINS

"Whenever the British people have muddled through a war, there is a time of repentance and heart-searching," Sir Edward Cook has written in his admirable, if somewhat meticulous, two-volume biography of Florence Nightingale. The Lady With A Lamp pointed out that the mortality of the British soldier in the Crimea was higher than that in the Great Plague of London. The death rate among the Guards was double that of the civilian population, which was bad enough. Many of the deaths could be attributed to evil conditions in the hospitals themselves and most were preventable. The conditions called for a saviour and Miss Nightingale determined to be it.

To the queen she suggested the appointment of a Royal Commission to study sanitation in the army. She also proposed an Army Medical School. Having won the Court, the next and far more difficult and important task was to convince the ministers. Here she had a hard nut to crack in the Minister of War, a Scotch procrastinator named Lord Panmure. After much lobbying and jousting she finally induced this dour gentleman to agree to appoint the Commission, but it was six months before he actually did so. Miss Nightingale and her friends called Lord Panmure "The Bison." For a long time he was impervious to progress and resisted,

or tried to resist, all the advances of the insistent and irresistible lady, but in the end he was vanquished, as Dr. Hall and others had been.

The Chairman of the Royal Commission was Sir Sidney Herbert and among its members was Dr. Sutherland. Miss Nightingale was not a member, but she wrote most of the report, which was issued in January, 1858. Four sub-committees, with Lord Herbert as chairman of each, were appointed to carry out the sanitary reforms recommended, and they were put into effect, in spite of the dilatory tactics of The Bison. Miss Nightingale worked Lord Herbert for all he was worth, even after he became Secretary of State in 1859. She worked him so hard, in fact, that, partly as a consequence, he died in 1861, and thus ended a rare and most profitable friendship.

HOSPITALS AS HUMAN INSTITUTIONS

As the acknowledged hospital expert of the world, many plans for these institutions were submitted to Miss Nightingale. In 1859, for instance, after the appearance of her book entitled "Notes on Hospitals," the King of Portugal consulted her on this subject. During the preparation of the report of the Royal Commission, she had been asked to go over the plans for a new military hospital. Having invited comment, the War Minister then refused to accept the recommendations made. Her suggestion for the pavilion style of hospital was, however, the basis for hospital planning of the future.

The book on hospitals revolutionized the ideas of sanitation concerning these institutions and in its day was the most important contribution of the times. Miss Nightingale's fetish was fresh air, which she consid-

ered the most potent of medicines. Significant as was her stimulation of sanitation in hospitals, that is, the improvement of the environment and of physical conditions, the real hospital reformer of the times was Lord Lister, who introduced the principle of asepsis, which made surgical operations safe instead of invariably fatal as they had formerly been. When Miss Nightingale was in training at Kaiserwerth, Lister had been a medical student, and when she was helping to design hospitals and train nurses for them, he was already a celebrated surgeon. Miss Nightingale was, however, apparently never a great admirer of Lister; she scoffed a little at his ideas and she did not follow them. The Lady With A Lamp was not one who followed others, she led them, or tried to.

From the reform of hospital construction to the improvement of hospital statistics was an easy and logical step and was the next constructive effort of the laborious invalid. In this endeavor she had invaluable aid from Dr. William Farr, the foremost statistician of the day and also the benefit of advice from M. Quetelet. She prepared model forms, which were approved by an international statistical Congress in 1860. Then she proposed that the census of 1861 include better vital statistics, but this was too much to expect of the slow-moving English census officials. Sir Edward Cook has called Miss Nightingale "The Passionate Statistician."

THE FOUNDATION OF MODERN NURSING

The year 1860 marks the real beginning of modern nursing, for it was then that the Nightingale Training School for Nurses opened at St. Thomas Hospital. Miss Nightingale was too ill at the time to be present, but

she always took much interest in the school and in her later years made fervent addresses to the graduates, and her house served as the mecca for ardent pilgrimages of the students, who visited her somewhat sacred presence with reverence and awe.

In the year before the opening of this school, there had appeared Miss Nightingale's epoch-making book entitled "Notes on Nursing," which for many years was the bible of the profession. This book, praised by Harriet Martineau as a work of genius, had great popularity, some 15,000 copies being sold within a month. As a best seller, it was read by every class of the people, from queen to scullery maid, and not only did it evoke tremendous interest in nursing, but it exerted much influence on the household hygiene of the day.

Support for the new nurses' training scheme came lavishly from all quarters, except from the medical profession, which was a unit in withholding assistance. Why, it is difficult to say, unless the reason is that the professions are invariably slow in making progress and in accepting any reform. The Nightingale School flourished, nevertheless, and served as the model for similar institutions throughout the world. To-day nursing is distinctly a profession, one in which the requirements are high and the qualifications for securing the "R. N." (Registered Nurse) are rigidly upheld and enforced.

NURSING IN AMERICA

Although attempts to train nurses in the United States were made as early as 1798, when Dr. Valentine Seaman instituted some feeble courses at the New York Hospital, scientific nursing in this country dates from a

decade after the beginning of the Civil War. The first "trained" nurse in America was Linda Richards, who graduated in 1872 from the New England Hospital for Women and Children, which had begun nurse training in 1860. She later took post-graduate work at the Nightingale School, as did other American nurses of influence. Miss Richards died on April 16, 1930, at the age of eighty-nine, in the hospital where she had trained.

During the Civil War, our army had no nurse corps, though it made some progress in medico-military matters after the usual bad start. Nursing and relief matters in this conflict were largely in the hands of an extra-governmental body, known as the Sanitary Commission, which was formed in 1861 to devise means of aiding the medical service of the army. In view of the present interest of life insurance companies in the promotion of the public health, it is worth noting that the first financial supporters of the Sanitary Commission were life insurance concerns. The bureaus of inspection of the commission, which were never popular in general army circles, revealed many insanitary conditions in camps, especially near Washington. After the disastrous battle of Bull Run, seventy-five questions as to the physical, moral and hygienic conditions of the troop were addressed to the already harassed government, and much popular sentiment in favor of improvement was aroused. After a change in bureaucratic attitude, more adequate hospital facilities were established.

Medical and sanitary organization continued bad during much of the Civil War. There was, however, a superintendent of nurses, appointed by the Secretary

of War, and this was no less a personage than the then sixty-year-old Dorothea Dix, who like Mrs. Fry in England, was chiefly noted for her efforts in behalf of prison and asylum reform, and who was instrumental in getting established St. Elizabeth's, the government hospital for the insane in the District of Columbia.

By the time of the War with Spain in 1898, there was a goodly number of more or less trained nurses in the country and the army employed some 1,700 of them. They were needed, because most of the army was sick during this most discreditable episode in the sanitary history of our country. The Army Nurse Corps was created in 1901 and has been an important part of the military establishment ever since. In 1912 the Superintendent of Nurses, Miss Jane A. Delano, conceived the really brilliant idea that the American Red Cross could become the developing ground for nurses for the army and navy. She resigned from the army and devoted herself to this duty until her death in France in 1919, with the consequence that over 7,000 Red Cross nurses were enrolled when the United States entered the World War. During this war, the American Red Cross supplied our forces with nearly 18,000 qualified nurses.

THE RED CROSS MOVEMENT

The American Red Cross as we know it to-day was organized only a little more than twenty years ago, though this great humanitarian movement began nearly seventy years ago, more or less as a direct result of the labors of The Lady With A Lamp. Florence Nightingale did not found the Red Cross, but her work served as the inspiration to others, and she was awarded a

Red Cross medal in 1867. In 1859 Henri Dunant, a young Swiss, organized a corps of volunteers to search for and nurse the wounded at the battle of Solferino, where the forces of Sardinia and France sought to throw off the yoke of Austria from Italy.

A month after this battle, M. Dunant proposed an international society of succor, with an emblem recognized by all. His efforts did not bear fruit until 1863 when a conference was held at Geneva to consider voluntary, non-combatant aid for the medical service of armies. A treaty was adopted and as a compliment to Switzerland, whose flag is a white cross on a red background, the emblem chosen was a red cross on a white banner. The red cross has always denoted self-sacrifice and service, for it was the symbol of the crusaders and of the two great orders of Knighthood, the Templars and the Hospitalers. It was the badge of Saint George, the valiant, and of Sir Galahad, the pure of heart.

At the Geneva convention the United States was informally represented by the European Agent of the Sanitary Commission. This commission was the real precursor of the Red Cross organization in this country, because in 1866 a number of men who had been prominent in this agency formed a permanent relief organization, with the red cross for insignia. This body disbanded in 1871, and was not revived for ten years, though in 1877 Miss Clara Barton, who had been active in nursing during the Civil War, delivered a message to President Hayes from the president of the International Red Cross, urging the formation of an American Red Cross.

A Red Cross organization was finally formed in

1881, with Miss Barton as first president, and in 1882 the United States, with customary tardiness, adopted the Geneva treaty. One of the first relief jobs of the Red Cross was in connection with a yellow fever epidemic in Florida in 1888, to which nurses were sent. During the War with Spain, much relief was attempted in Cuba.

The American Red Cross was finally and permanently incorporated in 1905, after Miss Barton had been released from her duties, on account of an alleged rather distressing lack of business methods. Miss Mabel T. Boardman has acted as secretary of the organization ever since, and there have been executive directors such as Ernest P. Bicknell before the World War, Henry P. Davison during it, and Dr. Livingston Farrand and Judge John Barton Payne since. To describe the health activities of the Red Cross since its re-creation in 1905 would, of course, require several books. In time of epidemic or earthquake, volcano or tornado, flood or any other disaster, it has been ready to minister to the needs of suffering humanity, with a spirit and an efficiency reminiscent of the angel of the Crimea. I know whereof I write in this regard, because for several years after the close of the World War, I had the pleasure of serving as assistant to Dr. Farrand in the development of the post-war health service of the Red Cross.

COURIERS OF THE GOSPEL OF GOOD HEALTH

The Red Cross movement received great impetus during the Franco-Prussian War in 1870 and Miss Nightingale served so effectively as counsellor to both combatants that each rewarded her with decorations.

About this same time she was also much concerned with sanitary affairs in India, a subject which had intrigued her attention for many years. As early as 1859, for instance, she had written a report on health conditions in India for a Royal Commission appointed to investigate the death rate of British soldiers in that part of the empire. The government of India was not favored by the home government with a copy of this report until six months after it appeared.

After 1872 Miss Nightingale was, as she said herself, "out of office." She eschewed politics, or vice versa, and she was able to devote more time to the school for nurses at St. Thomas'. Her quest was for more Agnes Joneses, the lady who bore this name having been a brilliant young gentlewoman who served as superintendent of nursing at the Liverpool Infirmary in 1865, and whose untimely death occurred in 1868.

Fifty years after the divine call had come to The Lady With A Lamp in 1837, she was in virtual retirement although still active in many lines and particularly interested in the school for nurses. Queen Victoria's Jubilee Year occurred in 1887 and one of the activities inspired during the celebrations in honor of it was an Institute for Nurses, the purpose of which was to improve methods for nursing the sick poor. District nursing was already in vogue, having started as early as 1859 in Liverpool, which needed it. The standards for such work were raised when the East London Nursing Society took action in 1868 requiring all district nurses to be gentlewomen.

Although in virtual retirement, Miss Nightingale continued to wield a pungent pen. In her many magazine articles there frequently occurred the phrase

"health nursing," by which she meant that her disciples should be interested not only in treatment and cure, but in prevention. Her basic thought was excellent, though by this time her ideas of hygiene were a trifle out of date. The brilliant discoveries of the great Pasteur meant little to her and their marvellous application by Lister probably meant even less. But the idea was a valiant one and its steady development has meant the growth of a branch of nursing which is as distinct from the profession as the sanitarian is from the physician. To-day we have bedside nurses who attend to their individual patients in institutions or at home, but we also have public health nurses, whose patient is the community as a whole. Their duty is not only to give treatment and care, but advice. They are teachers of hygiene and sanitation and instruct those who need such information, who comprise most of the population.

Miss Nightingale went even further than expecting the district nurses to be carriers of the gospel of good health, for in 1890 she started the experiment of training "Health Missioners." These were women who had received instruction in hygiene from the local health officer and who, after passing an examination, were given certificates. The same idea is now used by the Red Cross, whose nurses have instructed thousands of women in home hygiene and care of the sick and awarded them handsome diplomas for their proficiency in this important subject.

Although Florence Nightingale spoke often of "health nursing," the term "public health nursing" did not become prevalent until 1912, when the National Organization for Public Health Nursing was organ-

ized in the United States. Since 1877 when the Women's Branch of the New York City Mission began this type of nursing service, it had been called visiting nursing, and many organizations had been undertaking it, two of the notable pioneers having been the Boston Instructive District Nursing Association, founded in 1886, and the Nurses Settlement, later famous as the House on Henry Street, established by Miss Lillian D. Wald in 1893. The Henry Street nurses were the first to do school nursing, having started this activity in 1902. The American Red Cross inaugurated a rural nursing service in 1912, which was soon enlarged to a Town and Country Nursing Service and is now called the Bureau of Public Health Nursing. To-day there are at least 20,000 public health nurses in the United States. The total number of registered nurses in this country is about 200,000, though there are also estimated to be about 150,000 so-called practical nurses.

ONE LAMP GOES OUT

After 1894 Florence Nightingale was unable to leave her room and gradually became less and less active. Although she had never yielded to any person in her long and colorful life, she was forced to bow to the inexorable power of Old Age. In 1907 when her mind was no longer alert, King Edward conferred on her the Order of Merit, given only to those who had rendered especially meritorious services to the Empire, and awarded for the first time to a woman. Not understanding what was this honor, but faintly realizing that something had been done, the lady whose lamp was now very dim, murmured, "Too kind, too kind." One of those who has written of her declares that this,

at least, was not ironical, but in saying this, the writer, Mr. Lytton Strachey, evidently overlooks the real achievements of this remarkable Victorian. If ever a medal was properly, if somewhat tardily, bestowed, this one was.

The flame of the lamp went out on August 13, 1910, when Florence Nightingale had reached the age of 90. Westminster Abbey was offered as a last resting place, but in accordance with her wishes, the body was taken to Hampshire to lie in the green fields beside her father and mother. The lady whose lamp had been the torch of hope for the British soldier was borne gently to her grave by six stalwart sergeants of the Guards and this was the only military ceremony, though an honor that was as sincere as merited. No inscription marks the modest stone monument, only the initials "F. N." and the words, "Born 1820. Died 1910." There might appropriately have been added to them the passage from Shakespeare's "Cymbeline," which Miss Nightingale always considered the perfect description of a nurse:—

> "So kind, so duteous, diligent,
> So tender over his occasions, true,
> So feat, so nurse-like."

MANY LAMPS BURN ON

The one lamp was extinguished, but not the heritage. The founder of modern nursing built well and true, for her disciples have taken over the torch and carried it forward. In hospitals and homes, on the battlefield and in the great factories of peace, many Lamps burn on. There are in the United States to-day about 200,000 graduate nurses, trained in accordance with careful

standards, frequently increased and improved, but reverting in their origin to the wise recommendations of Florence Nightingale, one of the truly great sanitarians, who has marched in the story of health.

In the main hall of the white marble building which is the headquarters of the American National Red Cross in Washington, there was hung at the end of the World War, a great red and white banner. It is spangled with 19,877 blue stars and 292 gold ones, representing the nurses who served, and who died in that conflict. The gold stars shine with a fire which no mortal hand can diminish, but the gleam of the living is greater. In the cities where there is struggling and sorrow, where there is a striving for health and life, in the rural districts where distances are far and hardships almost overwhelming, in all kinds of weather, under all sorts of conditions, The Lady With A Lamp makes her rounds. This lady is the public health nurse, the courier of the gospel of good health. Carrier of hope, messenger of hygiene; the lamp is an eternal light.

VI

THE SURGEON WITH AN IDEA

Long after medicine had become an art, as it did eventually, surgery was still a trade, and none too respectable a one. In the Middle Ages, when medicine was making some advances, surgery was consigned to barbers, bath keepers, and seventh sons, male offspring of this numerical position apparently occupying a somewhat renegade status. In the fourteenth century a physician and surgeon who had several popes among his clients managed to lend some dignity to the profession, but it continued to be a field for wandering charlatans, executioners, sow-gelders, and other menial cutters.

EARLY WIELDERS OF THE SCALPEL

This was not the case prior to the Dark Ages. In the days when demons cavorted in men's bodies, ancient medicine men had a deft way of letting them out. These primitive surgeons trephined the skull, or in other words, bored a neat hole in it. If the patient recovered, as he probably did now and then, he was theoretically freed of his devil. The rite of circumcision was also practised in ancient times and the oldest record of a surgical operation, on the doorpost of an Egyptian tomb near Memphis, dating from 2500 B. C., depicts this ceremony, as well as several others.

The use of the knife for excision of a tumor is mentioned in an Egyptian papyrus of about 1500 B. C., and Homer, who wrote in 1000 B. C., alluded to Machaon

and Podalirius, the sons of Æsculapius, as warriors and surgeons. War was, in fact, the event which always gave the most impetus to the development of this branch of the healing art. Most men labored to devise ways of destroying life, but a few endeavored to learn how to restore and repair. Not until gunpowder had been invented in the sixteenth century, however, did the great master of surgery appear. Even he had been a barber.

In the long period from 1552 B. C. to 1552 A. D., when Ambrose Pare, the former barber who became the friend of four kings, amputated a leg without cauterization, much progress was made in the art of surgery. According to the Talmud, the ancient rabbis knew how to treat wounds, and Hippocrates, the Father of Medicine (460–369? B. C.), wrote several books on surgery. The Susruta of India mentions many surgical operations and instruments. In the first century A. D., Celsus wrote the first treatise in Latin on the subject and in it apologized profusely for employing the vulgar and immodest word "hernia," which, as everyone knows, is the medical name for rupture.

There were many other notable surgeons in ancient and early mediæval times. Among them were Galen (131–201 A. D.) and the two Ephesians, Soranus and Rufus. About a thousand years later, not much progress in surgery having transpired in the meantime, the leaders were Avicenna (980–1036), the Persian, and Albucasis, the Arab, who died in 1105, and who preferred to be called by his full name, Khalaf Ibn Albas Al-Zahrawi. Although the gentlemen named were all physicians of repute, surgery soon degenerated, at least with respect to its practitioners. In these Middle Ages there were many monks, all of whom had to be shaved.

The barbers who served them also performed the operation of blood-letting, and gradually assumed other surgical prerogatives. The modern barber's pole of red and white stripes is a relic of these old days, as it represents the bandages applied to the bloody parts by the barbers of old.

THE BARBER-SURGEONS

Until Guy de Chauliac came along in the fourteenth century (1300–1370) and operated for cataract and hernia, these duties had always been in the hands of strolling mountebanks. Most of the physicians of the time were also priests and eschewed the sight of blood. De Chauliac was outside the secular group, but he was, nevertheless, doctor for Popes Clement VI, Innocent VI, and Urban V, who were sojourning at Avignon. Most of the other surgeons of the time were barbers, and not much else.

A guild of barber-surgeons, with a licensing board, was set up in Paris in 1268, but so many practitioners disregarded the matter of registration, as some do, or try to do, even to-day, that the order was re-enacted in 1352 and again in 1364. A few years later, Charles V issued an edict permitting the barbers to treat wounds. About this time there grew up a distinction between surgeons of the long robe and surgeons of the short robe, the former being surgeons and the latter only barber-surgeons. The relative values placed on the three main branches of the healing art of the period are indicated by an order of 1383 directing four physicians, two surgeons, and six barbers to visit the sick, during one of the ubiquitous epidemics. The respective fees

allowed were 300 livres to the doctors, 120 to the surgeons, and only 80 to the barbers.

Ambrose Pare came to Paris in 1532, when he was fifteen years old and got a job at the Hotel-Dieu as a dresser. He had already been apprenticed to a barber back in Laval in Maine, France, so he was well fitted to become an army surgeon, as he did when he reached the mature age of nineteen. Then began some real surgery, for Pare was the father of the modern art. He became so valuable in this field that he was the only Protestant in Paris knowingly spared in the massacre of St. Bartholomew, and he managed to die a natural death in 1590.

It has been said that the three great epochs in surgery were the coming of Pare, the discovery of anæsthesia, and the work of Lister. Of the last two, more will be said later. Pare not only developed successful methods for treating wounds, but made practical application of the ligature which had been devised by Lanfranchi of Milan. Pare treated fractures, invented instruments and artificial limbs, fought plagues and pestilences, quarantined lepers, and had a gorgeous time, despite the obloquy sometimes flung at him as a former barber.

Not until the middle of the eighteenth century were surgery and barbering finally divorced in England. About that time another notable figure had appeared on the scene in the person of John Hunter, a coarse and blustering Scotchman who was born near Glasgow in 1728 and died in London in 1793. In early life, after studying with his brother, William, a noted physician, he served as an army surgeon and then settled down in Leicester Square in London. The world soon beat

a path to his door, for he was one of the greatest of the surgeons of all time. He had many notable pupils, among them Edward Jenner and Sir Astley Cooper.

It was another man from Scotland who was a few years later to render the greatest of all services to surgery. This surgeon had an idea, an idea which in its practical application converted surgery from a technical subject which often benefited the operator more than it did the one operated upon, into a life-saving specialty of real value as a branch of the noble healing art.

THE SURGEON WITH AN IDEA

This young surgeon sat in his office at the Royal Infirmary in Glasgow one day in the year 1865. The date, March 12th, was to be a memorable one in the annals of public health, and the reason for its renown was to be, strangely enough, a leg. The surgeon was not thinking so much of legs at the moment, but of germs, for he was reading *The Journal* of the French Academy of Sciences which contained a paper by a certain chemist named Pasteur. The experiments described in this article, which he had read again and again, had come to the surgeon like a torch in the darkness. It had set him thinking about some deficiencies in the practice of his craft.

The surgeon, lately come from London, was intensely interested in those mysterious living organisms so fervidly depicted by M. Pasteur. If these germs cause putrefaction, he pondered, and putrefaction gives rise to the suppuration which is always found during or after surgical operations, why cannot suppuration be averted by methods similar to those used to prevent

putrefaction? This was a novel idea. If valid, it would revolutionize surgery, then the most dangerous branch of the healing art.

As the surgeon pored over the article in *The Comptes Rendus Hebdomadaires* of the French Academy of Science, there was a commotion outside and hurried calls for Dr. Lister. From dreaming he went to duty to find a badly mangled leg before him. A boy had been run over by a cart and had suffered a compound fracture, a condition which usually meant in those days that the boy would spend the rest of his life on one leg and crutches. But not this time. The young surgeon decided to put an idea into operation. Somewhere he had read of carbolic acid as a disinfectant for sewage and he had laid in a supply for use in the hospital, conditions in which seemed sometimes not unlike those in sewers. If carbolic acid could disinfect a sewer, it ought to do as much for a leg.

It did. The boy recovered in the rapid time of only six weeks, and, most marvellous of all, without any trace of the usually fatal suppuration. Antiseptic surgery had been born.

THE QUAKER BOY WHO WANTED TO BE A SURGEON

A hundred years after the birth of Joseph Lister in London on April 5, 1827, it was said of him by an eminent English divine that he was "one of God's greatest gifts to man." Nor was this unduly superlative, because, with the possible exception of the disclosure of the value of anæsthesia, no greater boon than the discovery of the principle of antisepsis has ever been conferred on surgery. Modern surgery, which is so significant to the welfare of man, dates from that day

when Dr. Lister had the courage and initiative to try out an idea which he believed to be sound. To Pasteur belongs the credit for the fundamental concept, but to Lister that of putting it to practical application.

Joseph Lister came from substantial English Quaker stock. His grandfather and father before him had been wine merchants, but the latter was no mean scientist himself. The elder Lister's avocation was the study of optics and in the course of his work he developed the achromatic lens, an important feature of the modern microscope. This contribution was obviously of vast aid to the development of the science of bacteriology, so that Joseph Jackson Lister, the father, properly earned his election as Fellow of the Royal Society by his own help to the budding science of public health.

Young Lister had hardly reached his teens before he announced that he intended to be a surgeon, a calling which was appropriate to members of the Society of Friends, whose religion kept them from the Army and Navy and did not particularly fit them for legal strife or the warfare of public service. His father was not particularly enthusiastic about this career, but wisely interposed no obstacles. Starting in 1844, nine years of university work, medical school, and hospital interneship, were spent by Lister in securing his cherished degree of medicine and his fellowship in the Royal College of Surgeons. Compare this lengthy period of real preparation for the practice of scientific medicine with that indulged in by some of the modern followers of various unscientific healing cults, whose complete course often consists of no preliminary training at all and then three years of so-called study, each

of the "years" actually being only six months, and some of that by correspondence. The regular medical practitioner of to-day must spend at least seven years and sometimes more, in academic, medical, and hospital work before he gets the "M.D.," and then he must pass a state examination before he can practise his profession. These are facts worth keeping in mind when choosing a physician, for it is well to remember that a Lister is somewhat preferable to a Cagliostro.

EDUCATION AND EDINBURGH

The education of a professional man does not stop with the acquisition of a degree, for that is only his mode of introduction into his chosen field. Next must come a gruelling apprenticeship, a period of mettle-testing which usually determines whether the neophyte is destined to achieve greatness or the reverse. At this period in the life of Lister, when his chief contribution to science was a study on "The Flow of Lacteal Fluid in the Mesentery of the Mouse," he was advised by one of his teachers, Dr. Sharpey, to go to Edinburgh and visit James Syme, the foremost surgeon of the day.

Lister went to Edinburgh at the age of 26, intending to remain one month; he stayed there seven years, and he was 50 before he returned to London permanently. A young man on the threshold of a career can derive inestimable benefit from the wise and considerate counsel of an older and more experienced teacher, and Lister immediately became the devoted protégé of the distinguished Syme. Although Lister was a Fellow of the College of Surgeons, he started at Edinburgh as a clerk, though within a year he had become a house surgeon. Syme treated him not as an incumbrance, but

as an equal, gave him plenty of professional work, and, more important, the advantage of his advice. His colleagues at the hospital called Lister the "chief," a sobriquet which graced him for many years. Such a title is worth having. It was also the one given by his students to the late Professor Sedgwick of the Massachusetts Institute of Technology a few years ago.

Not only did Lister gain valuable professional experience at Edinburgh, but he acquired a wife as well, for in 1856 he married Agnes Syme, the daughter of his friend and patron. This step necessitated his leaving the Society of Friends, for marriage outside the Quaker sect was forbidden. He became affiliated with the Anglican church, but he never gave up the felicitous custom of addressing his parents with the familiar "Thee" and "Thou" and in many other ways he always was a Quaker in spirit, if not in theological attachment. His marriage was an ideal one, though no children blessed the union, and it lasted for thirty-seven years. His wife died in Italy in 1893.

After a honeymoon in Europe, much of the time devoted to practical medical studies in Paris and elsewhere, Lister settled down in Edinburgh and began those fruitful investigations which were to make a science of surgery, and which were to aid materially in making the world a better place in which to live. About this same time, Florence Nightingale was zealously following up that remarkable work which she had begun in the Crimea in 1854 and which had such a salutary effect on the hospitals of the time. It was Lister, however, who really gave life to the patients in the hospitals rendered sanitary and comfortable through the efforts of The Lady With A Lamp.

CHARNEL HOUSES CALLED HOSPITALS

Conditions in hospitals up to the latter part of the nineteenth century were about as thoroughly bad as it was possible to be. In those days no one ever chose to be operated upon if he had the power to resist, for every wound, whether accidentally incurred or deliberately inflicted by the surgeon, was fairly certain to become septic. Suppuration was such a regular event that the surgeons had even invented the term "laudable pus" for the thick, heavy variety which flowed outwardly instead of inwardly. The patients died a trifle less readily when this was manifest.

Since suppuration had been regarded as a normal accompaniment of surgery since the days of Hippocrates, progress in the art of wielding the knife had been somewhat slow, inasmuch as certain operations were so invariably fatal because of infection that they were rarely if ever performed. Thus, the brain, the lungs, and the abdomen were shunned by the surgeon of the mid-nineteenth century, who more or less confined himself to attempts at the repair of wounds, the removal of limbs, and the lancing of boils, with an occasional cure for rupture or the perennial hemorrhoids. Even so, at least half of the patients died.

The surgeon himself apparently had little use for cleanliness, now such a scrupulous necessity in all hospitals. He often came to the operating room direct from the dissecting chamber, usually without washing his hands or instruments. The story is told of Sir Astley Cooper, the eminent surgeon who operated on George IV for a wen, that he visited his royal patient the following day and, despite the favorable progress

of the king, was most coldly received by him. On his return to his office it dawned upon the surgeon that when he had gone to his scrupulous patient he had been wearing a coat spattered with blood, and that his hands were also covered with this mark of his craft.

The greater the amount of blood and dirt on the surgeon's gown, the greater pride he took in it, for such was a mark of a busy practitioner. This operating garment was left hanging in a musty closet when not in use. The wound, swabbed with a marine sponge which was occasionally cleansed with soap and water, was closed with wire or silk with no attempt at sterilization. The patient who was not sacrificed to such methods recovered only by luck. Dr. James Y. Simpson, himself one of the leading surgeons, declared at this time that "the man laid on an operating table in one of our surgical hospitals is exposed to more chances of death than the English soldier on the field of Waterloo."

Conditions were so bad, in fact, that the term "hospitalism" was synonymous with disease. Several types of infections were especially rife, including our old friend Saint Anthony's Fire, or erysipelas; pyæmia, a form of poisoning; septicemia, the familiar blood poisoning; hospital gangrene; and tetanus, or lockjaw. All of these, of course, are germ diseases, but prior to the middle of the nineteenth century, when Pasteur began his famous researches, bacteria were unknown. No wonder that Simpson and others suggested that hospitals be made of temporary materials, so that they could be destroyed at regular intervals. Simpson cited figures showing that 855 fatalities had occurred out of 2,089 amputations in hospitals, though only 226 had died out of 2,098 operations in country practice.

Most cruel of all was the appalling mortality of women in childbirth. As midwifery had advanced, many lying-in hospitals had been established, especially for the poor. The bane of every one of these institutions was puerperal sepsis and some of them had such a bad reputation for the loss of mothers from this cause that women begged pitifully not to be taken to these dens of fever. This sepsis which too often converted child-bearing from a normal physiological event into a disease was an enigma to the doctors and was not finally conquered until the Lister methods of antisepsis were generally employed, though several physicians before Lister had tried to do something about this evil.

THE POET AND THE CRANK

As early as 1773 a wise physician named Charles White pointed out that puerperal fever was probably caused by the same things that caused ulcers and abscesses, but no one paid any attention to him nor to another progressive medical man, Dr. Gordon of Aberdeen, who declared in 1795 that puerperal fever was a contagious disease. Then along came a poet who was also a physician and a professor of anatomy at Harvard. Oliver Wendell Holmes is probably best remembered to-day as a writer of clever prose and occasionally brilliant verse, but he belongs to history as much for his essay on puerperal fever as for anything else.

In 1843 Dr. Holmes declared in a paper entitled "The Contagiousness of Puerperal Fever" that it was the physician and the nurse who carried this sepsis from one patient to another. Such an heretical onslaught on the smugness of medicine in the fabulous forties naturally brought down the wrath of the gods upon the poet,

instead of earning for him the gratitude which should have been his reward for telling his colleagues something to their advantage. One estimable physician seized his pen and wrote that Dr. Holmes' assertions were the "jejune and fizzenless vaporings of a sophomore writer." Puerperal fever was to this old duffer the will of God, not the carelessness of man.

Confirmation of Holmes' idea came from a Hungarian crank, at least that was the opprobrium by which he came to be known among most members of the profession. Ignatz P. Semmelweiss was working as assistant in a hospital in Vienna in 1847, when he noticed that puerperal infection was frequent in a ward served by medical students, but rare in one where midwives were employed. Next he did some post mortems and one day decided that the findings in cases of puerperal fever and of autopsies of persons dead of septic poisoning were similar. Immediately an order was issued that the medical students must disinfect their hands with chloride of lime before acting as obstetricians. As a consequence puerperal fever ceased in their ward.

Semmelweiss conveyed his ideas about childbed fever to the professional world and was laughed at. The opposition to his views was so violent that it drove him into an insane asylum in 1865, where he died of septic poisoning, due to an infected finger, incurred in attendance on one of his patients. Holmes and his Hungarian contemporary were forerunners of Lister, to a limited extent, but it was the last named whose epoch-making work really made possible the conquest of puerperal fever, as well as of all other septic conditions which had previously been associated with surgical procedures. Lister actually knew nothing of the notable work of

Semmelweiss until twenty years after his own introduction of antisepsis in the very year when the Hungarian died in a madhouse.

THE DISCOVERY OF ANÆSTHESIA

About this time when Lister was beginning to study medicine and Holmes was discoursing on puerperal fever, there occurred an event which was perhaps the most important incident in American medicine and certainly coeval in significance to antisepsis. This was the discovery of anæsthesia,* the use of which made possible great advances in the surgical art, as well as providing relief from agony for the patient. Anæsthesia and antisepsis converted surgery from cruelty to beneficence, and anæsthesia as well as bacteriology made possible the later work of Lister.

No more violent controversy has ever raged than that concerning the credit for this discovery. At least four persons were working with ether about the same time and each has his rabid partisans for priority in its use. To the impartial investigator there seems but little doubt that Dr. W. G. T. Morton, a Boston dentist, was the first to demonstrate the possibilities of ether as an anæsthetic. The novel term "anæsthesia" was suggested to Morton by his literary friend, Oliver Wendell Holmes, who thus has left at least one permanent contribution to the language.

The other claimants to the honor of having discovered ether for medical use were Dr. Crawford Long of Atlanta, Georgia, whose statue was in 1926 placed by his state in that more or less ghastly collection of statuary in the Capitol at Washington; Dr. Horace

*See "The Discovery of Anesthesia," by Dr. C. A. H. Smith, in *The Scientific Monthly* for January, 1927.

Wells of Hartford, Connecticut; and Dr. Charles T. Jackson of Boston. Dr. Long undoubtedly used ether at least two years before Morton did, but he had not made much progress when the latter gave his discovery to the profession in 1846. Wells had been Morton's partner and they had worked together on anæsthetics, but Wells committed suicide after failure to demonstrate the use of nitrous oxide for this purpose in 1845 before a clinic in Boston. Jackson, as professor of chemistry at Harvard, had instructed Morton and aided him in his chemical researches, but not enough to justify a claim to originality in the discovery of anæsthesia.

All of these gentlemen had dabbled in ether, but it was Morton who succeeded where the others failed. He was one of the earliest graduates in dentistry from the first separate dental school established in this country, the Baltimore College of Dental Surgery, founded in 1840. He and Wells set up in partnership in Boston, but soon separated because of lack of patients. Morton eventually got plenty of them, however, and became one of the city's leading practitioners. On the side he took medical courses at Harvard and there met Dr. Jackson, who discussed with him the possibilities of using sulphuric ether to deaden pain, and taught him how to make ether free from impurities.

Ether jags had been a popular diversion among medical and chemical students for some years, but not until Long got the idea of trying it on a patient, after observing these ether intoxications, had any one thought of this chemical in connection with surgery. After investigating the effects of ethyl ether on himself one day in September, 1846, Dr. Morton finally had the courage to administer it to one of his patients on September

30, 1846, in order to assist in the removal of a recalcitrant tooth. Encouraged by success he went to Dr. John Warren at Harvard and asked to give a demonstration before the surgical clinic at the Massachusetts General Hospital, the same place where Wells' experiment had ended disastrously. Warren consented and set October 16, 1840, as the date.

The day arrived and the leading surgeons of Boston gathered in the stately amphitheatre below the dome. It is chronicled of the time that most of them wore whiskers and frock coats, with their spare instruments tucked away in the pockets of the latter. Lister had not yet made sterilization a surgical by-word. Morton was late and the meeting was on the point of proceeding without him when he dashed in and explained that he had been trying to make a suitable inhaler.

The assembled surgeons had come to scoff at an expected fiasco, similar to that of Wells, but they remained to wonder and praise. Morton deftly anæsthetized the suffering patient and then turned him over to Warren for the operation. Instead of torture and writhing, the subject remained as if in slumber and the operation for extirpation of a tumor below the jaw was concluded without apparently disturbing the patient's peace. Then Dr. Warren broke the silence which had fallen upon the audience. "Gentlemen," he said, "this is no humbug."

Thus anæsthesia was born, but this bounty to mankind did not escape criticism and condemnation, even though further tests showed its value. Numerous efforts to discredit Morton were made and many of his vexed and envious colleagues branded him as a quack and a charlatan. This is often the reward of genius,

humiliation taking the place of the honor which is due. The only compensation Morton ever received was a gold medal from the French Academy of Sciences and an honorary medical degree from an American university. He died in poverty in 1868, three years after Lister had demonstrated his great principle of antisepsis.

One of the first surgeons in England to use the new system of anæsthesia was James Syme, who later became Lister's mentor at Edinburgh. The other noted surgeon, James Young Simpson, introduced the method into the practice of midwifery. A year later, on November 4, 1847, Dr. Simpson discovered that chloroform also had anæsthetic effects on human beings. Chloroform had been so named in 1834 by the French chemist, Dumas, who will be remembered as the teacher of Pasteur. This anæsthetic became especially popular after 1853 when Queen Victoria sanctioned its use on the occasion of the birth of Prince Leopold, but at first it met with the same opposition as did ether. Simpson thundered at his detractors and overcame them. Later, as we shall see, he became a detractor himself, though in another capacity, and was overcome.

Anæsthesia was of importance to surgery not only by rendering the patient impassive to pain, but by obviating shock, and also by reducing the haste which had previously been necessary. It is recorded that Lister as a student once witnessed the removal of a leg at the thigh in twenty-five seconds, no anæsthesia, of course, being used. During the twenty years which were to elapse before Lister achieved a second revolution in surgery, much progress was made in the art of using anæsthetics, not the least of which was the invention of the hypodermic syringe by Alexander Wood in 1853.

THE SURGEON AT GLASGOW

After seven years of successful efforts at Edinburgh, Lister was suddenly promoted from the rôle of an assistant there to that of a full professor of surgery at the University of Glasgow. He was then, in 1860, only thirty-three years of age, but he had already made his mark and had contributed extensively to the art of surgery. He was, for instance, the only person outside of London who was invited to write monographs for the leading encyclopædic text on surgery. His subjects were anæsthetics and amputations. This was no mean compliment, for the outlying sections and those who lived and worked in them were considered just as provincial then as they often are to-day by the scientific denizens of metropolitan areas. Lister may have lived in the provinces, but he soon demonstrated that Edinburgh and Glasgow could be superior to London in surgical affairs.

The Infirmary at Glasgow, though one of the best hospitals in the British Isles, was the usual type of dirty institution of the period. The wards, built over or near pits where some 5,000 victims of the cholera epidemic of 1849 had been buried, were always overcrowded, usually with injured workmen from the numerous industrial plants. Safety campaigns were not in vogue in those days, any more than was sterilization. Every kind of septic poisoning and suppuration was endemic, epidemic, and pandemic, and more patients died from gangrenous causes within the hospitals than from pestilences outside.

Really progressive surgeons were, naturally, not content with these conditions. Lister had many a quarrel

with the hospital authorities about overcrowding and sanitation, but he was not always successful in securing improvements. A colleague named Spencer Wells was also harping on cleanliness and Miss Nightingale was on the crusading warpath. Bad air and dust were usually looked upon as the cause of trouble in operations and some attempts were made to do away with these evils. No real progress was made, however, until Lister applied his principles, based on the revelation which had come from the work of Pasteur.

PASTEUR SHOWS THE WAY

It was in 1865 that Professor Anderson, a chemist friend of Lister's, drew to his attention the studies of Pasteur. A modern surgeon, Dr. David Cheever, has written* that the product of Pasteur's mind struck a flame in Lister's intellect, as flint and steel ignite fire, and another writer, Dr. Cuthbert Duke, has said† that when Lister read Pasteur's material it was as if a man groping his way through the darkness suddenly perceived the pathway lit up by the dawn. Two of Lister's biographers, his nephew, Sir Rickman J. Godlee, and Dr. G. T. Wrench, whose book is written in a more popular style than Godlee's, have begun their chapters on this occurrence with an apt quotation from Pasteur himself, who wrote, "In the field of observation, chance only favors the mind which is prepared."

Pasteur, already a chemist of prominence in 1856, began in that year his researches on fermentation, which have been described elsewhere in this book. It will be recalled that he peregrinated up and down France with

*An article on Lister in *The Boston Medical and Surgical Journal* for July 16, 1927.
†"Life of Lister."

mysterious flasks which he opened here and there, in cellars, on mountain tops, and in vineyards and tanneries. He watched living organisms grow on the nutrient material in his flasks and he demolished the theories that fermentation was due to spontaneous generation. Instead, he showed that it was caused by these living germs, later called microbes.

Lister was so much interested in these experiments that he not only read them avidly, but he repeated them with a set of flasks of his own. For generations thereafter, in fact, he edified his students with demonstrations of flasks containing contaminated or unpolluted substances. Despite his admiration for the French savant, Lister did not begin to correspond with him until 1874, but subsequently many letters were exchanged between them, much to Pasteur's gratification, though no doubt the pleasure was mutual. Seven years after the beginning of this epistolary interchange between the two great sanitarians, Pasteur came to London and spent much time with Lister. The latter returned the visit in 1892 on the occasion of the celebration of the seventieth birthday of his colleague held at the Sorbonne. He delivered an oration on Pasteur's contribution to medical science, which so affected the emotions of the aged scientist that he rushed forward and publicly embraced Lister.

THE NEW TREATMENT FOR WOUNDS

How much difference between the respect and homage paid by Lister to the founder of preventive medicine and the reception accorded to the principle of antisepsis by some of the surgeons of the period. The most vicious opponent was no other than the great

James Young Simpson, who was considered by many to rank with Syme. Simpson had perfected a method of his own for treating wounds, as indeed had nearly every surgeon of the times, and he was distinctly piqued because that of Lister seemed likely to attract considerable attention. Simpson's scheme was known as acupressure, and consisted of thrusting a number of needles into the wound to take the place of a ligature.

The basis of Simpson's attack, however, was to the effect that carbolic acid was nothing new in the treatment of wounds. To this Lister, who was always restrained in a controversy, made a laconic reply, which only served further to infuriate his jealous and spiteful colleague. As a matter of fact, antisepsis was by no means a new idea, but its application to surgical operations most decidedly was. The term "antisepsis," unlike "anæsthesia," which was coined especially for that process, had been in use for a century before Lister. Even the mummies of Egypt bore witness to an ancient knowledge of the chemical prevention of putrefaction, though the climate of Egypt probably also contributed to the preservation of the embalmed pharaohs. Myrrh and balsam, alcohol and glycerine, and iodine and chlorine in various forms had been used for disinfecting purposes before Lister. Carbolic acid or phenol had been discovered in 1834, and when employed by Lister thirty years later was still in a crude form.

Darwin is said to have worked for a score or more of years on the theory of evolution before he was willing to give it to the world. Lister waited only two before he published the results of his antiseptic methods. He was not an author, but his paper required space in numbers of *The Lancet* from March to July, 1867. The appear-

ance of this article was the signal for Simpson to leap to the fray.

In this paper in *The Lancet* on "A New Method of Treating Compound Fracture, Abscess, etc., with Observations on the Conditions of Suppuration," Lister reported nine cases treated for compound fracture, with only one death from secondary hemorrhage, and only one leg lost from hospital gangrene. In this particular case, his second, the gangrene set in while Lister was absent from the hospital after the operation. Even with this one failure, the record was an unheard-of succession of triumphs over the deadly suppuration. Lister paid graceful tribute to Pasteur by writing that a flood of light had been thrown upon decomposition of organic substances by the philosophic researches of that scientist.

The wards which had been so unhealthy now became healthy and remained so as the antiseptic principle was continued. After nine months in which no cases of pyemia occurred, Lister was able to write to his father with pardonable pride, "Surgery is becoming a different thing altogether." In spite of this undeniable fact, only a few of the more liberal and enlightened members of the profession in Great Britain accepted at once, or reasonably soon thereafter, the revelation of a new method in surgery. The leading surgeons in Germany, especially Von Nussbaum and Von Volkmann, were more receptive, and after the Franco-Prussian War, which was a surgical horror, antisepsis and asepsis made rapid progress. The same was true on the Continent, but America was backward for once. Surgeons in the United States were most dilatory in accepting the new theory and as late as 1882 the leading text on a

system of surgery was, in the words of its author, "chary" about antisepsis and its "alleged" successes.

BACK TO EDINBURGH

Some seventeen years after the young surgeon had arrived in Edinburgh to become a clerk to Dr. Syme, he returned in quite a different capacity. He was no novice now and he came to succeed the great master in the chair of clinical surgery at the university, perhaps the highest honor in the field of his craft. Ill health had caused the resignation of Dr. Syme, who died a year after Lister's return. The students had unanimously petitioned Lister's appointment and the authorities were eager to add him to the illustrious group already connected with the university. Among the famous men on the staff at the time was James Bell, who is said to have been the prototype of Sherlock Holmes.

Two years after he had reestablished himself at Edinburgh, Lister introduced into surgery the one impractical thing which he devised. It was a carbolic spray, the object of which was to maintain a sterile atmosphere in the operating room. A rather elaborate piece of paraphernalia was evolved in order to fill the air with a carbolic mist and thus contribute to antisepsis. It may have done so, but its influence was slight compared to actual disinfection of the wound, and the chief effect of this spray was to irritate the exposed skin of the surgeon and give him a severe headache. During an operation on Queen Victoria in 1871, which Lister had been invited to perform by the royal physician, Sir William Jenner, some of this spray missed the abscess under the queen's arm and squirted in the regal face. The patient promptly complained to Dr. Jen-

ner, who humorously remarked that he was not to blame, as he was only the man who blew the bellows.

Lister persisted with his carbolic spray, although everybody else gradually abandoned it, until 1887, when he, too, gave it up as having only a restricted value. This step was misinterpreted in some quarters as a relinquishment of the theory of antisepsis by its discoverer, though of course it was not. Asepsis had been put forward by German protagonists as of paramount importance, but Lister never espoused it to the exclusion of antiseptic methods. Asepsis is the principle of rigid cleanliness and sterile conditions which will prevent the entry of any bacteria into a wound, while antisepsis is the principle of chemical disinfection of wounds so as to kill dangerous bacteria and thus prevent their growth and development. Modern surgery of course uses both impartially.

To balance against the one useless part of his surgical armamentarium, Lister contributed many practical and valuable assets to surgery, in addition to antisepsis. He was the first, for instance, to employ catgut as a ligature. After 1867 he had tied up arteries with silk soaked in carbolic acid, but having noticed that organized tissue replaced dead material, he began to look about for a ligature which might itself be absorbed. In order to find out he sacrificed a calf. While visiting his father at Christmas time, 1868, he transformed the latter's museum into an operating-room in order to chloroform a calf, one of his father's, and tie up the carotid artery in the neck with catgut which had been soaked in phenol.

A month later the calf was killed and the ligature found to have been completely absorbed. Thus there was made available another benefit to humanity. No

doubt those egregious persons who are so rabidly opposed to vivisection would condemn this operation on a calf, even though the result was a boon to mankind. In 1875 Queen Victoria asked Lister what he thought about the "horrible" practice of vivisection and Lister answered this somewhat deluded royal personage in no uncertain terms that it met with his approval, because it was not horrible, but conducted in a merciful manner for the benefit of the people as a whole.

The queen may or may not have been satisfied, but at any rate she appointed Lister as her personal surgeon in 1878. Those who do not understand the true purpose of vivisection, and have fantastic notions about its alleged cruelty and its unnecessary use are always the first when themselves afflicted to run to cover to a doctor or surgeon whose skill is based on knowledge made available through animal experimentation. Some of Lister's research had to be done in France on account of restrictions on vivisection imposed in England by misguided legislators. In his operation on Queen Victoria in 1871, Lister used another innovation, a rubber drainage tube. He had also experimented with new antiseptics and about this time introduced boracic lint.

LISTER GOES TO LONDON

In 1877 when he was fifty years old, King's College in London invited Lister to accept the chair of clinical surgery. There was no reason why he should, for the chair at Edinburgh was more honorable and he had appreciative students in large numbers, as well as a congenial circle of friends. And yet he did accept this call. Possibly the reason was because London had been less avid to adopt his theories than had the provinces; per-

haps he wanted to get back to the place of his birth and youth, as many of us do. At any rate, he went, taking some of his assistants with him, and during the next fifteen years was never as comfortable as he had been in Edinburgh.

The move to London was a mistake, but Lister managed to survive the disappointment which must have soon come to him. The students here were few and not particularly interested in a surgeon whose methods were regarded coldly by those who wrote the examinations for admittance to fellowship in the College of Surgeons. So Lister turned to research, conducted his large private practice, and went around to conventions. In 1876 he visited the United States to serve as president of the Section on Surgery at an International Medical Congress held in Philadelphia in connection with the Centennial Exposition. He addressed one of the meetings for two and a half hours and then answered questions fired at him steadily for another hour.

During his years in London, Lister contributed more to the art of surgery. He was the first to operate on cancer of the breast, now a common event, and he devised a scheme for wiring the kneecap when fractured, and he did the same for the elbow. A distinguished London surgeon who heard of this operation on the kneecap was reported to have remarked, "When this poor fellow dies, some one ought to proceed against that man for malpractice." No doubt to the disappointment of the commentator, the patient did not die. Lister, like Pare, was responsible for the invention of many surgical instruments, some of which are used to this day.

THE "WORLD" GOES TO LISTER

Patients now came to Lister from all parts of the world. He enjoyed this lucrative practice, though he was notoriously lax in keeping appointments and sending bills. He believed that a teacher ought to be in touch with the conditions about which he taught, as indeed he should. A full-time professor even in these modern times is a better professor if he practises his profession, whatever it is, on the side.

Many well-deserved honors came to Lister in his later years. In 1883 he was made a baronet and in 1897 raised to the peerage. He was the first medical man to receive this honor, though it came to him for his services to science generally. He took a seat in the House of Lords and actively participated in debates on medical subjects, such as the Vaccination Bill. He was, of course, an assiduous defender of vaccination as essential to national welfare.

At the age of sixty-five, in 1892, he retired from the chair at King's College and devoted the rest of his life to research and his patients. One of them, the poet Henley, has left us the best portrait of the great surgeon. His sonnet was entitled "The Chief" and it depicts the character of the man in the following lines:

> "His brow spreads large and placid, and his eye
> Is deep and bright with steady looks that still.
> Soft lines of tranquil thought his face fulfill—
> His face at once benign and proud and shy.
> If envy scout, if ignorance deny
> His faultless patience, his unyielding will,
> Beautiful gentleness and splendid skill,
> Innumerable gratitudes reply.

His wise, rare smile is sweet with certainties,
And seems in all his patients to compel
Such love and faith as failures cannot quell.
We hold him for another Heracles,
Battling with custom, prejudice, disease,
At once the son of Zeus with Death and Hell."

Like Pasteur, Lister was interested in the establishment of a great laboratory for preventive medicine, an institution which now bears his name. Pasteur's celebrated work on rabies and the necessity of sending persons infected with this disease to Paris for treatment, so aroused the British public that a movement was inaugurated for a laboratory devoted to the study of communicable diseases. The British Institute of Preventive Medicine was, accordingly, founded in 1891, with Lister as first chairman. The anti-vivisectionists made the usual misguided fuss and the laboratory received little financial support from the government, but it grew and prospered. In 1897 the name of Jenner Institute was proposed for the institution, but legal difficulties prevented. Finally, in 1903, this laboratory became deservedly known as the Lister Institute, an honorable name which it bears to-day. As in the case of the Pasteur Institute in Paris, many notable contributions to public health have come from this source.

When King Edward was crowned in 1902, after a delay in the date of the coronation due to an operation for appendicitis, he told Lister that if it had not been for the methods developed by the eminent surgeon, some other person would probably be receiving the crown instead of Edward VII. In the same year a banquet was held in Lister's honor by the Royal Society, which he had served as president from 1895 to 1900. In

the course of a speech, the American ambassador, Mr. Bayard, paid a striking tribute. "My Lord," he said, "it is not a profession, it is not a nation, it is humanity itself which with uncovered head salutes you."

Lord Lister suffered a slight stroke in 1903 and spent the next nine years in retirement. He died peacefully on February 10, 1912, and was buried in West Hampstead, though Westminster Abbey was offered. Like many of the great of the world, a modest monument marks his grave. It is a plain gray granite slab, with only his name and the dates of his birth and death inscribed upon it.

ONE HUNDRED YEARS AFTER

One of the tests of real fame is the appreciation of a man displayed by posterity. The words of Handel's anthem, sung at Lister's funeral, have long since come true, "His body is buried in peace, but his name liveth forevermore." Many notable ceremonies in honor of the Lister Centenary (1827–1927) were held in Great Britain and America in 1927, with much eloquent discourse, and with laudatory articles appearing in numerous medical and lay journals.

All this is no more than due to Joseph Lister. His was a great period in the advancement of public health, for not many an age can boast such contemporaries as Pasteur, Chadwick, Simon, Shattuck, Morton, Miss Nightingale, and Lister, to mention only a few of the more prominent sanitarians. Of these seven, one was a chemist, two were sociologists, one was a physician, one a dentist, one a nurse, and one a surgeon, which would seem to indicate that doctors of medicine have no monopoly on public health progress. Either that, or else

human advancement depends not on the possession of this or that academic or professional degree, but upon the personality of those who are great.

During the Lister Centenary festivities in his native land, King George V received at Buckingham Palace one hundred delegates from all parts of the civilized world. In replying to an address by Sir Ernest Rutherford, president of the Royal Society, in which he stated that it may well be doubted whether the scientific activity of any other man has achieved so much for the saving of human life and for the prevention and relief of the physical suffering of mankind, the king said that any country might be proud to claim Lister as its citizen. Joseph Lister, like Pasteur, does not belong to any one country, but to the world.

VII

THE CONQUEST OF YELLOW FEVER

"HELL hole of the Pacific" was the picturesque epithet given to Panama in the middle of the nineteenth century. The characterization was deserved, for this torrid region was indeed a veritable Hades, not because of the heat, but because of the ravages of a fatal pestilence. This was yellow fever. It took a tremendous toll from those adventurers who, lured by the lust for gold, attempted to cross the Isthmus from the Caribbean to the gulf, there to set sail for California and riches. My grandfather was one of those who fought his way through the jungles in the late fifties, and he was one of the fortunate few who escaped the fearful yellow fever. He returned later to New England with more experiences than gold.

THE TOLL OF YELLOW FEVER

Ever since the days of the conquistadores, and even before that time, yellow fever had been the scourge of Central and South America. There is strong probability that it was instrumental in the destruction of the marvellous Mayan civilization, which has only recently been brought to light again. The West Indies were never free from this pestilence and one of the epidemics there was responsible for the adoption of the first sanitary legislation in America, a maritime quarantine act passed by the Massachusetts Bay Colony in 1647.

Yellow fever did not hesitate even to invade the great northern republic. It was, in fact, such a frequent visi-

tor that some ninety epidemics of the disease were recorded in North America between 1683 and 1880. Once it struck as far north as Montreal, but the disease always had one strange characteristic. It inevitably receded as soon as frost came. We know now why this was so, but until 1900 no one understood the cause or prevention of this malady.

When yellow fever came, a panic somewhat akin to that created by the appearance of plague in the Middle Ages ensued. In 1793 the disease descended upon Philadelphia and caused much havoc. Business was disrupted and the whole social order disorganized. Corpses were disposed of without ceremony and people avoided the hearses. Handshaking was taboo and persons wearing crêpe were shunned as if they were lepers. In spite of the horror of the situation, most of the physicians of the city, helpless as they were, remained and fought the disease as best they could. Benjamin Rush wrote to a friend that it pleased God to enable him to stick to his principles, his practice, and his patients to the last extremity. President Washington remained throughout most of the epidemic, but finally retired to Mount Vernon. Alexander Hamilton was one of those stricken but, fortunately for American finance, he recovered.

This epidemic in Philadelphia, which took off ten per cent of the population, brought into being the first local board of health in America, created in that city in 1793. Yellow fever also caused the first state health organization to be set up, a temporary board established in Louisiana in 1855, though it was disbanded when the emergency was over. The disease was, furthermore, responsible for the first and only national board of health in this country. Severe epidemics occurred in

1873 and 1876 and then the worst of all came in 1878. This was so calamitous and so stirred the nation that Congress adopted a law for a national health board, which, as soon as the danger had passed, was allowed to become defunct for lack of Congressional support.

Both North and South were attacked by this vast epidemic of 1878, though Memphis and New Orleans were especially hard hit. About 100,000 persons were affected and some 20,000 succumbed. The financial loss ran into many millions of dollars, some estimates putting it as high as $200,000,000, though this sum is probably exaggerated. Whatever the loss, and it was great in both lives and money, there is emphatically no question but that epidemics do not pay. Even the President of the United States in 1878, Rutherford B. Hayes, seemed to have some such an opinion, for he sent a special message to Congress calling attention to the necessity of a more effective system of national quarantine.

NAPOLEON AND SAN DOMINGO

Yellow fever once performed a service to the United States, not by abstinence in its depredations on our citizens, but by confounding our enemies, or those who were potential foes. This event, in which yellow fever was for the only time our ally, occurred in San Domingo in 1802. In that year Napoleon, who had grandiose ideas for a vast colonial empire, sent an expedition of 20,000 picked troops to San Domingo, with the intention of conquering that country and then moving on to the banks of the Mississippi. The first aim was accomplished, but the second never was.

The subjugation of the disorganized blacks was an

easy task for the veteran French troops under General LeClerc. Toussaint L'Ouverture, the famous black leader, promptly fled to the interior, there to await the slaughter of his foe by the insidious ally, yellow fever. He predicted August as the time when no French would remain to combat him, and he was right, for within six months after the landing of the expedition in February, the French forces had been completely annihilated.

Within two months, in fact, two-thirds of the soldiers had perished of yellow fever. In despair Napoleon sent replacements, who survived no longer. These soldiers could fight human enemies and conquer them, but they were helpless against disease. With the disappearance of these troops, which, as one historian has written, "melted like wax in the sun," there vanished the hopes of Napoleon for his garrison in Louisiana and his American colonies. Although he had induced Spain to cede Louisiana back to France in 1800, he was glad of the opportunity to sell this territory to the United States in 1803, especially as war with England was threatened. Thus did yellow fever play a significant rôle in American history.

THE FORT BROWN INCIDENT

During a siege of yellow fever at Fort Brown on the Mexican border in 1882, a young army surgeon was sent to the post to assist in caring for the many patients. He was himself stricken with the disease, but fortunately recovered, as did also a young lady in whom he was interested and whom he later married. The term "fortunately" is used advisedly in narrating this case, for that young man was to be heard of again in connection with yellow fever. His name was Gorgas, William

Crawford Gorgas, sometime of Tuscaloosa, Alabama.

Since September, 1905, when Colonel Gorgas admonished a group of internes in Ancon Hospital to take a good look at a yellow fever case, as it was to be the last they would ever see, the former hell hole of the Pacific has been absolutely free from cases or deaths of the disease. Havana, also once a hotbed of this pestilence, has had no cases since 1905, when Colonel Kean cleaned it up for the second time, using the methods Gorgas had made famous in 1901. More remarkable still, yellow fever had by 1930 nearly passed from the face of the earth. It was the dream of Gorgas in his later life to write the last chapter in the history of yellow fever. That chapter is now nearly complete.

The victory over yellow fever is, however, by no means merely the story of the great achievements of Gorgas, for there were many men concerned in the romantic series of episodes which led to the conquest of this disease. Remarkable as was the practical application by Gorgas of proven methods for coping with yellow fever, even more marvellous were the investigations which produced those methods. Of the numerous heroic figures which are conspicuous in this drama, the most outstanding was Walter Reed, who was in charge of the commission which in 1900 investigated and found the real facts about the spread of yellow fever. It is related of General Gorgas that he was met one day in Washington by a friend, who introduced him to a granddaughter as one of our great men.

" 'No, my child,' said Gorgas in his soft accents, 'not a great man; merely one who is trying to follow in the footsteps of a great man—Walter Reed.' "*

*Gorgas, M. D., and Hendrick, B. J.: "William Crawford Gorgas—His Life and Work." 1924, Doubleday, Page.

MOSQUITOES ARE ACCUSED

In the days when yellow fever was at its height, as in 1853 when it destroyed 8,000 people in New Orleans alone, the disease was thought to be spread by infected clothing and rags. All kinds of peculiar and futile efforts were made to prevent the dissemination of yellow fever by these means. In 1848 a courageous physician of Mobile, Alabama, Dr. J. C. Nott, published a paper charging the mosquito with a part in the spread of yellow fever, but this allegation excited but little attention. No one dreamed of the real vector until in 1881 a shrewd sanitarian of Havana, Dr. Carlos Finlay, again accused the mosquito. His theory was met with the derision which most of the doctors of the day thought it merited. Finlay never himself proved his assertion, but he lived to see it proved.

Already the mosquito had been incriminated as a carrier of disease. In 1878 Dr. Patrick Manson, an English physician, demonstrated that certain worms called filaria could be found in mosquitoes and that they developed there. These worms caused a horrible disease in man known as filariasis, or more familiarly, in some of its manifestations as elephantiasis. Due to the invasion of the filaria various abnormalities occur in the structure and function of the body. Thus, the leg might be tremendously increased in size, which accounts for the term "elephantiasis" as descriptive of the condition. Fortunately, this malady is rarely seen in the United States, though it does occur in some parts of the South. The unique specimens of obesity occasionally encountered in our times are due generally to causes other than the filaria.

Manson later got a "Sir" to put before his name, but this honor was as nothing to that of having inspired a study which solved the problem of the spread of malaria.

ROSS ATTACKS MALARIA

Insects were getting into bad repute toward the latter part of the nineteenth century. In 1893 Dr. Theobald Smith of the United States Department of Agriculture had demonstrated that a cattle disease called Texas Fever was caused by infected ticks. A few years later Dr. David Bruce and Dr. Aldo Castellani in Africa showed that the terrible sleeping sickness of the Dark Continent was spread from one person to another by tsetse flies.

For some time Manson had had the idea that mosquitoes might have some connection with malaria. One day in 1894 he met in London a young doctor of the Indian Medical Service, a then rather obscure person named Ronald Ross. Manson told Ross of his theories and so fired him with interest that the latter determined to find out the truth.

Ross had already done work on malaria, for, after the microbe of the disease had been discovered by the French army surgeon, Laveran, in 1880, Ross had endeavored to isolate this protozoa by his own methods. In this attempt he was not successful, and so concluded that Laveran was also wrong. Manson convinced Ross, however, that Laveran was right, for he showed him the microbe under the microscope and Ross, believing, went back to India.

For about four years Ross tried to find out how mosquitoes carried malaria, and failed. His researches

were sandwiched in between various medical duties, fighting cholera and the numerous other plagues which are and always have been the blight of India. Finally, in 1898, he got established in Calcutta, and there he began to try to transmit malaria to birds, which, strangely enough, are susceptible to this disease. In this endeavor he was successful and he did it by means of mosquitoes, big brown ones of the genus *anopheles*. The problem was solved, though it was later found that different mosquitoes are implicated in carrying the disease between men than among birds. Nearly thirty years later, on June 7, 1927, a memorial gate to Ross was unveiled at Calcutta in his presence.

GRASSI ALSO SUCCEEDS

At about the same time that Ross was making his far-reaching discoveries in India, another sanitarian in Italy was also on the trail of malaria. His name was Grassi and he is said to have been inspired in his quest by reading the reports of Dr. Theobald Smith. This Grassi succeeded where the great Dr. Koch had failed, for Koch came to Italy to demonstrate also that the mosquito carried malaria from man to man. He and Grassi met, but went their separate ways.

Not only did Grassi show that a particular mosquito, the *anopheles,* transmits the disease by biting an infected person and then, after the proper period during which the parasite develops in the body of the mosquito, by biting a healthy person, but he also put into effect definite measures for the control of the disease in one of the malarious districts of his country.

For all this the Italians made Dr. Grassi a senator. The English gave Ross the "Sir" to put before his

name and he was later awarded the Nobel prize in medicine. Ross and Grassi were not in accord as to who deserved priority in the discovery, but, as Kipling says, that is another story. The discovery was made and it not only resulted in the development of methods for the control of this scourge but paved the way for the remarkable work which was to ensue with respect to yellow fever.

THE WAR WITH SPAIN

When the United States went to war with Spain in April of 1898, the principal fighting indulged in by our troops was not against the Spaniards, but against disease, a condition which has been frequently pointed out in this book as the chief characteristic of all military ventures. This time, disease was particularly rampant, due largely to the utter unpreparedness with which our country entered upon this conflict, and the complete ignorance of and disregard for sanitary measures displayed by those high in authority. As a consequence, some 3,500 men died of disease, while only 266 were killed in battle, and 275 died from wounds or accidents, out of a mean average strength of 235,631.

The chief causes of death were from typhoid fever, especially prevalent in the camps in the United States; and yellow fever excessively distributed among the troops in Cuba. Yellow fever, and also malaria, played havoc with our soldiers from the moment they landed in Cuba and by August, 1898, conditions had become so serious that the Army either had to be withdrawn, or it would have been completely exterminated by disease. The medical personnel was pitifully small and

inadequately furnished with supplies. It did the best it could under such adverse conditions, but since the exact manner in which yellow fever was spread was still unknown, no really efficient measures were adopted for its prevention. The observation was made, however, that yellow fever spread rapidly in the lowlands, but was rare in the mountainous regions, and this fact later offered a clue as to a possible means of spread.

Out of the War with Spain, disgraceful as it was from the general standpoint of preventive medicine, came three great contributions to public health. These were the report of the Typhoid Commission, consisting of Majors Walter Reed, Victor C. Vaughan, and Edward Shakespeare; the recognition and control of hookworm disease in Porto Rico by Captain Bailey K. Ashford; and the conquest of yellow fever. The Typhoid Commission showed that this filth disease was not only spread by contaminated water, but also by flies and most of all by personal contact; the work of Dr. Ashford, who had been an assistant to Walter Reed, revealed that the "tropical anæmia" of Porto Rico was in reality due to hookworms, not then known to exist in the Western Hemisphere; the Yellow Fever Commission, under Dr. Reed, proved that yellow fever is carried by a certain mosquito, and thus made possible the complete extirpation of yellow fever from the world. How successful has been the subsequent work is shown by the fact that in 1930 this formerly ubiquitous malady was to be found in only one or two places in the world, in Northern Brazil, and certain spots in Africa.

THE YELLOW FEVER COMMISSION

From the Army Medical Museum in Washington there went forth in 1900 a notable commission, which had been charged with the duty of investigating yellow fever. This commission, consisting of Drs. Walter Reed, James Carroll, Jesse W. Lazear, and Aristides Agramonte, was to accomplish one of the most astounding feats in the story of health. Dr. Agramonte had, incidentally, been at one time on the staff of the New York City Health Department under Dr. Hermann M. Biggs.*

The situation found in Cuba was a desperate one. Although Major William M. Black of the Engineers and Major William C. Gorgas, the sanitary officer, had, in accordance with the orders of General Leonard Wood, the military governor, made Havana by far the cleanest city in the world, yellow fever had diminished not at all. In fact, due to the arrival on the island of some 25,000 Spanish immigrants, there was more of this disease than ever before. One third of General Wood's staff had succumbed. Something had to be done and done quickly.

The first thing the commission attempted was to discover the microbe of yellow fever, which an Italian scientist named Sanarelli claimed to have found in 1897. They failed in this endeavor, but did show that Sanarelli's organism was the same one which caused hog cholera and that it did not cause yellow fever at all. Then the commission turned to Dr. Carlos J. Finlay's theory that the mosquito was the carrier and in this idea they received cogent support from Dr. Henry R.

*See Chapter IX.

Carter of the United States Public Health Service, then in charge of quarantine at Havana. Dr. Carter had seen many cases of the disease in our southern states and had made the important observation that a certain time must elapse between infections. This he called the "extrinsic incubation period" and when he told Reed about this fact, Reed replied, "There must be a mosquito host."

Several members of the commission had already been bitten by mosquitoes, particularly the stegomyia, which was the most prevalent species of these noxious pests, but nothing had happened. Then came the dramatic incident. On August 27, 1900, Dr. James Carroll offered himself as a possible sacrifice to science, for he deliberately submitted to the bite of a mosquito which was believed to be a carrier of yellow fever. This mosquito had feasted on a patient and had been kept for an appropriate time thereafter so as to allow the development of the germ in her body. The result was that Dr. James Carroll contracted a severe case of yellow fever, from which he almost died. Fortunately, with expert medical attention from Major Gorgas and others, he recovered.

Dr. Carroll lived long enough to be nearly forgotten by his government, but he will not soon be forgotten by science, nor by posterity in general. His exploit and those of others in this warfare against disease were as much deserving of the Medal of Honor as any valiant act on the actual field of battle. Another hero was a buck private of the Cavalry, named William Dean, who submitted to the bite of an infected mosquito soon after the nearly disastrous experiment on Dr. Carroll. Private Dean, known in the official reports

only as "X. Y.," also came down with yellow fever, but luckily he recovered. Proof of the rôle of the stegomyia was gradually accumulating. It received more verification soon after.

LAZEAR

On September 13, 1900, Dr. Jesse W. Lazear was working in a yellow fever ward, when one of the striped, so-called tiger mosquitoes, which had apparently been a regular inhabitant of the ward, alighted on his finger. Deliberately he allowed it to drink its fill. That was real courage. Dr. Lazear had no delusions about the pleasures of an attack of yellow fever and he knew that it was often fatal. Jesse W. Lazear died on September 25, 1900, of yellow fever. Gentleman and soldier, martyr to science, *requiescat in pace.*

The evidence pointed to the mosquito of a certain species, the *Stegomyia fasciata* (now called *aëdes aegypti*) as the carrier of the disease. Further proof was needed, however, and so the commission established an experiment station, appropriately named Camp Lazear, six miles from Havana. General Wood, who had himself been educated as a physician and appreciated the significance of the proposed tests, asked for more volunteers from among the American troops in Cuba.

HEROES OF HEALTH

In answer to this call, two intrepid individuals came forward. They were Private John R. Kissinger and Civilian Clerk John J. Moran. The purpose of the experiment and its risk were thoroughly explained, but Kissinger and Moran were willing to go on, without

compensation of any kind, except the gratification of having served humanity. "Gentlemen," said Walter Reed, major in the army of the United States, to this private and this clerk, "I salute you," and he touched his cap, with deep emotion.

Kissinger was bitten on December 5, 1900, by mosquitoes which had previously fed on yellow fever patients, the proper time of fifteen to twenty days having elapsed. Within four days he was sick with yellow fever, but he got the very best care that could possibly be given to any man and he recovered. Moran was also bitten, but failed to develop the disease. Five Spanish immigrants were likewise included, and four of them came down with yellow fever. The immigrants were apparently more interested in the two hundred dollars which each received than in any contribution to science.

Twenty-seven years after Kissinger's heroic exploit, there appeared in the New York *Times* for March 21, 1927, the following headline:

AID SOUGHT FOR HERO OF YELLOW FEVER WAR

Ex-Soldier, Who Volunteered for Infection 27 years ago, Now Ill and in Need.

The news item which followed related that a group of scientists and medical men was endeavoring to raise a fund of $5,000 to care for the later years of this ex-soldier, now fifty years old, and broken in body, but not in spirit. He had always refused to ask help, getting along on a pension of $100 a month awarded by a grateful, more or less, government. This news item called forth an editorial in *The Times* the next day and many communications from readers, as well as some

substantial contributions. The public does well not to forget such items as medical bravery, even after three decades have passed. Mr. Kissinger and his family moved into a new home in June of 1927.

After the mosquito biting experiments, came a demonstration to show that infected clothing played no part in the spread of yellow fever. Three more volunteers, Dr. R. P. Cooke and Privates Folk and Jernegan of the Hospital Corps, slept for twenty nights in bed clothing which had been actually used by yellow fever patients. The room was kept dark, damp, and warm, so that it resembled the dank and musty hold of a ship. For sheer bravery I think these men deserved many medals, for every one had been positive before the experiment that this was the way to transmit yellow fever. A second and then a third test proved conclusively that it was not.

The final demonstration was to show that miasma and air had no influence by themselves on yellow fever. Another room was constructed and divided into two parts by a screen partition. The room was well ventilated and properly screened. In order to show that it was perfectly safe, four men slept in it, two on each side, for two weeks, without result. Then Reed let loose a flock of yellow fever mosquitoes on one side and sent Civilian Clerk Moran in on three successive days. This time Moran got the disease, but fortunately pulled through. Two other men slept on the other side of the partition all during the test, but as they were protected from the mosquitoes, none contracted the disease. Similarly, when the mosquitoes had been removed, the other side of the room caused no harm.

Here then, by this brilliant series of experiments, was the knell of yellow fever sounded. For more than

two centuries yellow jack had ravaged the tropics, but his doom was sealed. It has taken a quarter of a century to complete the job, but it has been done. Walter Reed, whose name is perpetuated on the great army hospital in the national capital, died suddenly of appendicitis on November 23, 1902, but he lived long enough to see the successful application of his work in the fever-ridden city of Havana. Dr. Agramonte was the only survivor of the commission in 1930.

PARTICIPANTS IN THE YELLOW FEVER EXPERIMENTS IN CUBA*

MEMBERS OF THE BOARD

Major Walter Reed	Virginia.
Major James Carroll	England.
Dr. Jesse W. Lazear	Maryland.
Dr. Aristides Agramonte	Cuba.

INOCULATED WITH YELLOW FEVER

Private John H. Andrus	Pennsylvania.
Mr. John R. Bullard	Massachusetts.
Private A. W. Covington	North Carolina.
Private William H. Dean	Ohio.
Private Wallace Forbes	Illinois.
Private Levi E. Folk	South Carolina.
Private P. Hamann	Germany.
Private James F. Hanberry	South Carolina.
Private Warren G. Jernegan	Florida.
Private John R. Kissinger	Ohio.
Mr. John J. Moran	Ohio.
Private Wm. Olson	Wisconsin.
Private Chas. G. Sonntag	South Carolina.
Private Clyde L. West	Georgia.

*From an address by Surgeon-General M. W. Ireland, U. S. A., printed in *The Military Surgeon*, February, 1929. Congress gave the survivors belated pensions and medals in 1929.

SLEPT IN INFECTED BEDDING

Dr. R. P. Cooke, A. A. Surgeon	Virginia.
Private Thos. M. England	Ohio.
Private James Hildebrand	Georgia.
Private Edward Weatherwalks	New Jersey.

GORGAS CARRIES ON

Major William Crawford Gorgas was chief sanitary officer of Havana when Reed was performing his sanitary marvels, and to him fell the task of putting into practical effect the disclosures made by the Reed Commission. He began active operations against mosquitoes in March, 1901, using methods which had been suggested by the chief of the United States Bureau of Entomology, Dr. L. O. Howard, who, by the way, still occupied this position in 1929 after continuous service in the government since 1878 and as chief of the bureau since 1894. Gorgas was, however, somewhat conservative and he did not abandon the useless disinfection of clothing until August, believing that caution was still demanded.

Although some persons, physicians as well as others, thought that the work of the Reed Commission was of academic interest only, and that it was impossible to extirpate the billions of stegomyia mosquitoes, Reed himself was sanguine and wrote to his friend, Dr. L. O. Howard, on January 13, 1901, that, "with Howard and Kerosene we would soon knock out old culex fasciatus," which was then the cognomen given to the yellow fever mosquito. Colonel Jefferson R. Kean relates* that on a Christmas tree at Columbus Barracks in 1900, Reed's gift was "a wonderful stegomyia made

*Editorial in *The Military Surgeon,* March. 1925.

of a champagne cork with a formidable proboscis, and tooth-pick legs beautifully banded, while Dr. Amador, the post sanitary officer, received a *can of kerosene* as his badge of office with doggerel verses describing the pursuit of the mosquito."

Gorgas was not the first to attempt mosquito extermination, for, while he still hesitated, post surgeons were busy, under orders from General Wood, with the oil can and ditching implements. Gorgas, however, soon gathered a corps of able assistants, chief of which was Joseph Le Prince, a sanitary engineer, and began the operations which were eventually to be famous. His success in ridding Havana of the stegomyia and of yellow fever is now history.

Because of the opinion that mosquitoes could not be extirpated, the sanitary authorities of Havana, headed by Dr. Juan Guiteras, attempted preventive inoculations, which they thought might be effective in the same manner as smallpox inoculation. For this purpose they used infected mosquitoes, one in particular donated by Dr. Reed, which on account of its importance was dubbed "Her Ladyship." It is the female of the species, incidentally, which is the dangerous member of the family, while the male is harmless. The method of inoculation was not successful and several lives were lost in this endeavor, including that of a brave American nurse, who volunteered to undergo this treatment.

The Gorgas attack on the mosquito did show results, however, and day by day progress could be noted. The year before the work was begun, in 1900, there had been 310 deaths from yellow fever; subsequent to 1901 there were only five, though as previously stated there

THE STEGOMYIA SQUAD, HAVANA

From "Sanitation in Panama," by W. C. Gorgas. D. Appleton & Co.

OILERS AT WORK IN A MARSH, PANAMA

was a flare-up in 1905, which was competently handled by Colonel Kean. Dr. Reed, back in Washington, watched the results with much interest and was generous in his praise of Gorgas, who, in turn, gave credit to Reed for having been the guiding spirit in the matter. The triumph at Havana made a tremendous public impression and came at a time when the United States had a new problem before it, that of conquering disease in Panama, so that a canal could be built across the Isthmus.

MAKING POSSIBLE THE PANAMA CANAL

Never did the torrid Isthmus more deserve the sobriquet of "hell hole of the Pacific" than during the eight years when the French attempted to dig a canal through the forbidding jungle of Panama. This extravagant venture was rendered futile by the consistent enemy of man, yellow fever, which carried off laborers as fast as they could be sent to this terrible part of the world. Although no accurate records were ever kept, it is reliably estimated by Gorgas and others that the French lost about one third of all their white employees, or some 20,000 lives.

Yellow fever was directly responsible for the failure of the French at Panama. When, therefore, the United States, by virtue of the political genius of Theodore Roosevelt, acquired in 1904 the territory and the right to undertake this job, Doctor Gorgas, who was now a colonel as a result of his achievements in Havana, suggested to his chief, Surgeon-General Sternberg, that the experiences of the French with disease ought to be avoided. In spite of his spectacular accomplishments in Cuba, few of the high officials at Washington

seemed impressed with the necessity of sanitation, in the scientific sense. They wanted the stinking pest holes, Colon and Panama City, at each end of the Isthmus cleaned up, because the innumerable odors were offensive but these blind officials cared little for the mosquitoes, except as they were annoyances.

Gorgas was, however, selected in 1902 as chief sanitary officer for Panama and, after some preliminary investigations, he arrived at the scene of combat in June, 1904. With him were Mr. Le Prince, Dr. Carter, who was to be quarantine officer, Major Louis A. La Garde, and several others. From the beginning this party was hampered by lack of equipment, lack of funds, lack of assistance, and lack of appreciation. The situation was so discouraging that Gorgas returned to Washington in the fall to endeavor to stimulate some support. He returned with not much, except his wife, but that item was worth a great deal. Gorgas, unfortunately, had no General Wood to support him at Panama as he had at Havana.

The first governors of the Canal, who did most of their governing from swivel chairs in the Capital, until one after another were fired, were intolerant and openly contemptuous toward the sanitary ideals of Gorgas, who was looked upon as a benevolent crank. A less persistent and altruistic man would have thrown up his job in disgust and there might have been no canal to this day. Gorgas knew what was coming, however, and when yellow fever descended, as was inevitable, he was prepared.

The epidemic began late in 1904. The usual panic occurred with it, and but for the lack of shipping facilities, most of the working forces would have decamped.

To leave the hell hole was the ambition of every one. Then Gorgas, with a trifle more co-operation than he had previously enjoyed, started active operations against the stegomyia. Much to the irritation of all of the officials, he neglected cleaning up the filthy cities on the coasts, for, as he well knew, mosquitoes and not filth caused the spread of yellow fever.

Due to his insistence in going about his scientific duties in his own way, Colonel Gorgas nearly lost his place. Regardless of a report by a former president of the American Medical Association to the Secretary of War highly commending the work of Gorgas and decrying the red tape and senseless opposition to his methods, and strong support from his superior, Surgeon-General O'Reilly, some members of the Isthmian Canal Commission wanted to get rid of Gorgas, and one of them, Shonts, had his own candidate, an osteopath, to replace the eminent conqueror of yellow fever. There were also other medical aspirants. Again the situation was serious.

Theodore Roosevelt had done a courageous and statesmanlike thing by arranging to build the canal in the first place and he now made a move which was equally important. After consultation with some eminent members of the medical and engineering professions, he determined to back up Gorgas to the limit, and he did. The Commission became more cordial and Gorgas himself eventually became a member of it. In 1906 Mr. Roosevelt visited Panama and personally inspected the medical and sanitary work, which made a great impression upon him.

VICTORY AGAIN

By the end of the third year of the work on the canal, yellow fever had been banished. Gorgas had repeated his triumph at Havana and had gained renewed fame. Then, in 1908, a new commission, comprised mostly of army officials, was appointed to supervise the construction of the canal. Colonel George Goethals was chairman of this commission, of which Gorgas was a member, and for the next seven years the sanitary work was carried on under the difficulty of having no sympathy from the chairman, who apparently looked upon it as an expensive fad.

The story is told in the excellent, though sometimes a trifle exaggerated, biography of Gorgas* that Colonel Goethals remarked one day, "Do you know, Gorgas, that every mosquito you kill costs the United States Government ten dollars?"

To which Dr. Gorgas retorted, "But just think, one of those ten dollar mosquitoes might bite you, and what a loss that would be to the country."

Despite the handicaps, however, yellow fever was banished from Panama, once called "the white man's grave." Gorgas and his able assistants persisted and not only exterminated yellow fever, but made effective attacks on other diseases, particularly malaria. The pest holes which went by the name of cities at each end of the Canal were likewise abluted and to-day they are models of cleanliness and purity, that is from the sanitary standpoint.

There is no question but that sanitation made possi-

*Gorgas and Hendrick: "William Crawford Gorgas, His Life and Work." 1924, Doubleday, Page.

ble this great engineering feat. The American nation has a right to be proud of the Panama Canal as a tremendous achievement, but much of the ultimate glory belongs to Colonel Gorgas and his sanitary cohorts. Once the rendezvous of the buccaneers, formerly the graveyard of the conquistadores, the scene of tragedy and failure, of pestilence and horror, Panama is to-day the gem of the tropics, a monument to the conquest of disease. When the night falls now on the graceful palms in the valleys and the majestic mountains beyond the edge of the jungle, when the starlit air is fragrant with the scent of a thousand tropical flowers, peace and security descend on Panama, for the genius of man has made it safe and salubrious.

The lesson of Panama went around the world. In 1914 Colonel Gorgas was invited to go to South Africa to advise on sanitary conditions in the mines on the Rand, where the chief problem was pneumonia. While on a visit to Rhodesia, Gorgas was informed that he had been appointed Surgeon-General of the United States Army. He served in the capacity throughout the World War, until three days after the armistice was signed in 1918, when he was retired for age. He died on July 3, 1920, in London while en route to Africa to make further studies on yellow fever. Mrs. Gorgas died on November 8, 1929.

A magnificent funeral service for General Gorgas, benefactor of humanity, was held in St. Paul's Cathedral in London. "He passed through the great door through which the sun streams into the nave of St. Paul's and there he lay with Nelson and Wellington and all that mighty host who came this way and passed into the universe."

On a sunlit day in August of 1920 I was one of a respectful multitude which stood in the golden sunlight outside of old Epiphany Church in Washington. An artillery caisson was before the door and a troop of cavalry was drawn up on the street, which was also lined with many soldiers. Suddenly the great doors swung open and a reverent hush fell on the assembled crowd. Somewhere a bugle call rang out and, at the command of "present arms," sabres flashed and rifles swung into place as a thousand soldiers stood at attention and every civilian uncovered. To the softened strains from a military band, a flag-covered casket was borne from the church by a group of generals and placed reverently on the gun carriage. In a few moments there was the measured tread of many marching feet, the clatter of hoofs, and the rumble of the caisson, as all that had been mortal of William Crawford Gorgas was on its way to its eternal rest on the green slopes at Arlington. When a bugle was blowing taps, the city had gone back to work.

NOGUCHI

The silver notes of taps have sounded for a number of other intrepid fighters against yellow fever. In 1918 the disease itself claimed three noted investigators, who were working in West Africa, the last great home of the yellow plague. They were Adrian Stokes, the gallant Irishman, Hideyo Noguchi, the mild little Jap, and William A. Young, the British pathologist. All died in line of duty, but before they succumbed each made his notable contribution to man's knowledge about this pestilence.

Noguchi had sailed for Africa in October of 1927

as the consummation of a life-long desire to battle with the enemy in its own territory. A month before he departed, Dr. Adrian Stokes, the Irishman who was born in France and educated in England, and who had fought in the World War, contracted yellow fever at his post at Accra on the Gold Coast of Africa. Before his death, Stokes had shown that the yellow fever on this continent was caused by one of those invisible, filtrable viruses, which the microscope cannot detect. By experiments on monkeys he had also proven that the disease could be contracted through the unbroken skin from the blood of patients, as well as by the bite of the infected mosquito.

These findings were confirmed by Noguchi, who already had some experience with yellow fever. In 1918 he had gone to Guayaquil, Ecuador, to study yellow fever for the Rockefeller Foundation, and during the next six years he made three more expeditions to this South American country. On each one of them he had found in the blood of patients a spiral-shaped germ which he called the *Leptospira icteroides* and which he thought was the cause of the disease. Time has cast doubt on this fact, especially in view of the work of Stokes, which Noguchi checked, but there is no doubt but that the spiral is present in yellow fever cases. Whether it gives rise to a separate disease similar to yellow fever, or whether it is a secondary invader remains to be ascertained.

For his work at Guayaquil, Noguchi was made a colonel in the Ecuadorian Army, given a decoration to wear, and was offered a mansion to live in. But he returned to his real home, his laboratory in New York, there to carry on other researches which added to his

fame and contributed to the conquest of the diseases which inflict mankind. After Noguchi's death in Africa, Dr. Young attempted to complete his experiments, but died a week after, a victim of yellow fever. In May of 1928 there was another casualty at this African station, Dr. Paul A. Lewis, who also died of yellow fever.

Hideyo Noguchi was born in the mountains of Northern Japan on November 24, 1876. He came of a poor family, but through the interest of a local samurai, Mr. Sakae Kobayashi, who later became his adopted father, the boy received a good preliminary education. The successful treatment of a deformity of his left hand, incurred when he was two years of age, and corrected when he was a young man, interested him in medical science. He graduated from the Tokyo Medical College in 1897, and in the following year became an assistant to Dr. Kitasato, who had been a pupil of Robert Koch.*

The young Japanese physician came to America at the end of 1899 and went to the University of Pennsylvania, where Dr. Simon Flexner,† whom he had met in Japan earlier in the year, was occupying the chair of pathology at the medical school. Dr. Flexner put him to work on a study of snake venoms and methods of immunizing man against them, a piece of research which was originally supported by the late Dr. S. Weir Mitchell, celebrated as an author as well as a physician.

*Flexner, S.: "Hideyo Noguchi, A Biographical Sketch." *Science,* June 28, 1929.

†On Nov. 21, 1929, Dr. Flexner was one of nine men honored by the New York State Chamber of Commerce for services to mankind. Of him the chairman said, "He has illuminated the problem of epidemic diseases, discovering the toxins of diphtheria, a curative serum for cerebrospinal meningitis, and identified the infectious germs of infantile paralysis."

When the Rockefeller Institute for Medical Research was opened in 1904, under the direction of Dr. Flexner, Noguchi became one of its valued staff members. While there he did some notable work on the diagnosis of syphilis, and he also investigated many other diseases, such as Rocky mountain spotted fever, infantile paralysis, rabies, kala-azar, the Oroya fever of Peru, and trachoma, the eye disease which is especially prevalent among American Indians and in many of our rural states. In 1926 he discovered an organism which seems to be the cause of trachoma.

At the time of Noguchi's death in Africa on May 21, 1928, it is said that a severe storm was raging. "His life has been a series of struggles," wrote his friend, Mr. Kobayashi, in his eulogy, and continued, "Providence did not give him peace even on the verge of death, for Seisaku,* the child, had dreaded above everything —thunder." On the great roll of history the name of Noguchi takes its place with the many martyrs who have laid down their lives in the cause of science, men whose names reverberate down the long corridors of time.

YELLOW FEVER ON THE WANE

A world-wide campaign against what was left of yellow fever was inaugurated in 1916 by the International Health Board of the Rockefeller Foundation. General Gorgas was invited to act as a consultant and visited Central and South America to see what could and should be done. He recommended that the centres of infection, the foci from which the disease spread out,

*In accordance with Japanese custom, Noguchi had changed his first name from Seisaku to Hideyo when he reached manhood.

be eradicated. Measures were, therefore, promptly begun at Guayaquil in Ecuador, Merida in Yucatan, and in Northern Brazil.

Cuba and Panama were not the only scenes of triumph over yellow fever. Inspired by the work of Gorgas, Rio de Janeiro had been rid of the disease by similar methods under the direction of Dr. Oswaldo Cruz, and Vera Cruz, once a hotbed of yellow fever, was likewise freed from the scourge by Dr. Liceaga. This left, however, certain sources of infection in South America from which the disease now and then broke loose and went on the rampage.

With the assistance of the experts of the International Health Board, yellow fever has been gradually disappearing from the world. First it was driven out of the Amazon Valley in Brazil and also from Ecuador. An epidemic broke out in Peru in 1920, with 20,000 cases, but it was vanquished by heroic measures against the mosquito. Various budding epidemics were also nipped from time to time throughout Central America. In Mexico, operations by the Board were closed in 1923 and turned over to local authorities for the necessary continuous follow-up. In 1927, however, yellow fever reappeared in Brazil and in the following year sporadic cases occurred in Rio de Janeiro for the first time in twenty years, with a full-fledged epidemic on the scene in June, 1929.

When the New World was apparently safe from the ravages of yellow fever, attention was turned to the last remaining endemic centre, on the West Coast of Africa. Headquarters were established in Nigeria in 1924 and the fight was on. The report of the International Health Board for 1925 stated that, on account of al-

most insurmountable difficulties, the African studies promised to be at once the most interesting and most challenging in the history of the yellow fever campaign. Events have indeed proven that to be the case. The writing of the last chapter is under way, and while its completion has been deferred, the end seems definitely in sight. In few other diseases has man already made such noteworthy conquests.

DENGUE ALSO VANQUISHED

Among the most recent of the great studies on mosquito-borne diseases was one made in 1925, which deserves special mention as a climax to the events related in this chapter. It was conducted in the Philippine Islands by officers of the Army Medical Department and resulted in ascertaining the method of transmission of the disease known as dengue fever. This is a debilitating though seldom fatal malady which occurs in tropical and semi-tropical regions and has been endemic in certain of our southern states for many years. The mosquito has long been thought to have been incriminated in the spread of this disease, but the correct mosquito was not recognized until exactly identified by these Philippine studies, which were under the direction of an army board, the chairman of which was Lieutenant-Colonel J. F. Siler.

As in the case of the experiments by Walter Reed on yellow fever, volunteers were called for from the ranks of the Army. In this instance sixty-four men responded. They were non-immune to dengue fever and when bitten by dengue-carrying mosquitoes of the genus Aëdes, forty-seven cases occurred. Another kind of mosquito, with the musical name of *culex quinque-*

fasciatus, which had been falsely accused in the past of criminality in connection with the spread of dengue, was found to be not guilty.

The cooperation of these volunteers in the experiment, which, as stated in an official commendation of their acts, involved a limitation of personal freedom, as well as discomfort and physical suffering above and beyond the normal requirements of duty, produced results of much practical civil and military value, for now this disease can be sent into oblivion, along with yellow fever.

In the conquest of yellow fever the world has had its most striking demonstration of the achievements of sanitary science. Despite the tremendous advances made in other respects and the accomplishments against other diseases, none has, on the whole, been so completely vanquished as has this terrible scourge. The future may see conquests as brilliant, but the past has furnished a tradition and a heritage which will forever be an inspiration and a stimulus to the modern profession of sanitarians.

VIII

TRUDEAU AND TUBERCULOSIS

No longer does tuberculosis deserve the appellation of "Captain of the Men of Death" bestowed upon this devastating disease some years ago by Sir William Osler. Until 1912, when heart disease passed tuberculosis in the mortality tables, the latter disease had always been the leading cause of death in the United States. Now it occupies fifth place, being exceeded not only by heart disease, which at present causes twice as many deaths as tuberculosis, but also by kidney disease, pneumonia, and cancer. In a few years tuberculosis will probably be even much further down the list of the slayers of mankind.

During the last quarter of a century the death rate from tuberculosis has decreased by more than half. In 1900 the great white plague took off in excess of 200 persons of every 100,000 in our population, but in 1928 this rate had been reduced to about 79 per 100,000. Except for typhoid fever, few other diseases can show such a striking diminution. Naturally, the efforts of sanitarians, physicians, sociologists, and others to bring about this remarkable result form a most significant and interesting chapter in the general story of health.

THE NATURE OF TUBERCULOSIS

While tuberculosis has been demoted from a captaincy to a lieutenancy among the agents of death, it has by no means yet been extirpated, as has yellow fever, nor has it been reduced to almost a curiosity like

typhoid and smallpox. Tuberculosis is still very much with us, for it causes approximately 100,000 deaths annually and it is estimated that there are at least a million persons sick from the disease every year, with half a million under constant treatment. Although a diminishing problem, it is none the less still a serious one.

Unlike most of the communicable diseases of bacterial origin, which are usually acute and quick in their action, tuberculosis is generally slow and insidious in its development, and chronic in its course. There are some rather acute forms of the disease, but most of the cases are of long duration. The tubercle bacillus probably gets into the system of most people in early childhood, but whether the germ ever causes the disease to develop or not depends upon various conditions, but especially upon the vital resistance of the individual. His susceptibility may be affected by numerous environmental factors such, for instance, as constant exposure to deleterious substances like silica dust. Consumption, or tuberculosis of the lungs, is the most common form of this disease, though there are a number of other types.

A stealthy disease must be fought by methods and maneuvers which are different from the stratagems employed against the quick-acting maladies. The campaign against the white plague has been going on for more than two decades, with forces marshalled against over-crowding, ignorance, apathy, and insanitary conditions generally, as well as tactics to provide adequate and practical hospital and dispensary services for the isolation and treatment of the tuberculous, facilities for the early detection of the disease, and proper nutrition. No struggle in jungles is this, but a constant effort in a

highly developed civilization, for phthisis is chiefly a disease of civilization. Primitive races have been free from consumption until superior races have brought it to them. Who does not remember the havoc caused in the South Sea Islands by this disease in particular, bestowed on an innocent people by traders and missionaries?

Many persons have participated in the fight on tuberculosis. The man whose name heads this chapter may not have been the greatest of them, but he is the one as much worth telling about in detail as any. The story of Trudeau is, moreover, also that of numerous others, for no man had so many ardent friends and collaborators and he lived at a time when great events were in the making. Many economic, sociological, and biological factors, as well as medical and sanitary ones have been concerned in the story of the partial conquest of tuberculosis, though the narrative is not a formidable one, but simple and picturesque, as well as dramatic. What episode in the story of health is not?

VICTIMS OF THE WHITE PLAGUE

Like the Black Plague of the Middle Ages, the White Plague of modern times has left few families unscathed by its attention. Many a young adult of promise has succumbed in the prime of life to the ravages of this ruthless disease. If a list of all the famous people who have died or suffered from tuberculosis were compiled, it would take up many pages and would comprise the names of statesmen, generals, artists, writers, and captains of commerce. Royalty has been attacked with the same zeal as less favored classes of humanity. Who does not recollect the pathetic story of the son of Na-

poleon, called by Rostand, "L'Aiglon," who succumbed in his teens to tuberculosis?

Among the many victims of the white plague there have been the poets Shelley, Keats, Byron, Pope, and Goethe; the painter Raphael; the philosophers Voltaire, Kant, and Emerson; the writer of music, Chopin; and the authors Balzac, Kingsley, and Robert Louis Stevenson, besides such others as Molière, Ruskin, Heine, Samuel Johnson, and John Locke. There have been physicians and social workers, too, but not every person who has been attacked by the disease has yielded to it. Dr. Victor C. Vaughan, for instance, relates how he was threatened with consumption as a youth, but overcame it. He lived to serve many years later as president of the National Tuberculosis Association, and at the age of seventy-five wrote his very interesting and instructive memoirs.*

THE LONG HISTORY OF PHTHISIS

Tuberculosis is one of the diseases whose history goes far back in the history of the race. Its social and economic effects have been tremendous during the course of the centuries, and physicians have ever been alert to develop their knowledge of its cause and prevention. In the struggle for mastery over the white plague, nearly every century has added something, though there have been long intermissions, as in the Middle Ages, when the period from the third to the seventeenth centuries was devoid of progress in fighting phthisis, the name given by the Greeks to this wasting disease.

*"A Doctor's Memories." Bobbs-Merrill, 1926. Dr. Vaughan died of heart disease on November 21, 1929, at the age of 78.

The whole story of the gradual conquest of tuberculosis would obviously be a long one. Several years ago one of the leaders in the battle on the white plague published a book of nearly 500 pages, in which he traces in detail the development of the modern knowledge about the disease.* In it he analyzes the innumerable writings of a host of indefatigable investigators, though, strangely enough, he says very little about Trudeau. As in the case of any of the great plagues which inflict humanity, an account of some of the most noteworthy events leading to the ultimate victory is always of interest.

The Laws of Manu of India, written thirteen hundred years before Christ, contain the earliest known record of tuberculosis, though there is good reason to believe that the disease existed in Egyptian antiquity and in the land of the ancient Hebrews. Some of the diseases described in the Old Testament, which the prophets so kindly and charitably wished on their enemies, were undoubtedly forms of tuberculosis.

The Chinese had recognized the white plague as early as the sixth century B. C. and the Greeks and Romans were familiar with it. Hippocrates wrote about diseases of the respiratory tract and mentioned many deaths from phthisis. The treatment advocated by the Greeks consisted mostly of a diet of milk, which is still considered a sound basis for cure, though the ancient Hellenes put goat's and ass's milk ahead of cow's for this purpose. Among the Romans, Pliny, Celsus, and Galen all wrote extensively on phthisis, and the doctrines of the last named prevailed for many centuries.

*Flick, Lawrence F.: "Development of Our Knowledge of Tuberculosis." 1925.

He also recommended the milk diet, though preferring breast milk to all others.

HEALING BY THE KING'S TOUCH

The King's Evil was a disease widespread and well known in mediæval times. This malady was not of venereal origin, as its name and the prevailing chastity of the various anointed sovereigns of the period might lead one to expect. Instead it was scrofula, called by Shakespeare "the mere dispair of surgery," a form of tuberculosis of the lymphatic glands, often characterized by external suppurating abscesses. Among those who suffered from it was Dr. Samuel Johnson, who went to Queen Anne to be touched by the regal hand in order that he might be cured. The royal touch was a failure in this instance, as, despite popular acclaim, was usually the case.

The king's touch is one of the most ancient forms of healing. It began with the Merovingian kings in the sixth century, but reached greater prominence under Philip I of France in the eleventh century. The custom journeyed to England with the Norman Conquest in that century and was continued for many years thereafter. It is alleged that Charles II touched 100,000 persons, or almost half of the whole nation. The king not only laid on hands but presented the supplicant with a gold piece, or "angel," which stimulated the Bard of Avon to the comment that "he cures hanging a gold stamp." In discussing this ceremony, one editorial writer has remarked that "this seems to be the only instance in medical history in which a patient got paid for being cured."*

**Journal of the American Medical Association*, Feb. 19, 1927.

In England this superstitious practice languished after the death of Queen Anne, though it survived in France until the Revolution removed the royal touchers from the healing horizon. Before this ritual was abandoned in England, a celebrated quack named Valentine Greatrakes, who had arrogated to his own clumsy, peasant hands the regal prerogative of curing, had reaped the usual fortune from a gullible public, which even now will often go to a spine pusher. Greatrakes eventually came to a bad end, and scrofula continued to exist until competent surgeons learned scientific facts about this condition.

FROM SYLVIUS TO VILLEMIN

The first of the great tuberculosis workers after Galen was a Dutchman, Francis de la Boe Sylvius, who taught at Leyden from 1648 to 1672. His books on the subject are reputed to be worth study even to-day. It is not even inconceivable that many well-educated modern physicians might learn something to their advantage from these old timers, for history is one of the best teachers. Sylvius was followed by Richard Morton of London, who wrote a terrifically pretentious and complex volume called "Phthisiologia," in which, among other things, he asserted that consumption was caused by blood-spitting. Although he had the cart before the horse in this instance, Morton did make a number of valuable contributions to the knowledge of tuberculosis.

A former keg tapper was the next to contribute to the advancement of our knowledge of tuberculosis. Leopold Auenbrugger (1722–1809) had been raised in a village in Austria where his father was an innkeeper. Kegs constituted an important part of the armamen-

tarium of taverns in those days and Papa Auenbrugger went about tapping them to find out whether they were full or empty of the various cheering beverages. Many years later when the son, Leopold, was a full-fledged doctor, he remembered that kegs filled with liquid produced a different sound than did those containing air. He tried out this tapping on the body of a man recently dead of tuberculosis and later performed the rite on several pneumonia victims. Out of these experiments came the art of percussion, which is one of the essential features in the diagnosis of tuberculosis.

Several years after Auenbrugger had died, noted as a composer of music and not as a physician, a French doctor made another important contribution to the diagnosis of the disease which was to cause his own death. Rene Theophile Hyacinthe Laennec (1781–1826) was studying medicine under Napoleon's physician, Corvisart-Desmarets, who taught his long-named pupil how to percuss. One day, however, there came to Dr. Laennec a young lady. Because of her sex, the physician could not with propriety, in those days, apply his ear to her chest while he tapped, and so he rolled a piece of paper into a tube and listened through it. From this beginning developed the stethoscope, that telephone-like instrument which is indispensable to every member of the modern medical profession. Ten years after this remarkable discovery, Laennec himself succumbed to tuberculosis.

Laennec was not the first to die of this disease, more or less in line of duty, for several years earlier Dr. William Stark of London, a pupil of John Hunter, died in his twenty-ninth year of an acute tuberculosis infection probably contracted while performing an autopsy. Dr.

Stark had collaborated with Benjamin Franklin, the American scientist and statesman, on studies on diet. One of the earliest American physicians to investigate tuberculosis was Benjamin Rush of Philadelphia, who wrote several papers on the subject. He did not, however, espouse the famous cowhouse treatment of Dr. Thomas Beddoes, an English contemporary, who put his patients to bed in cow barns because he considered the exhalations of such establishments to exert a beneficial effect on the course of the disease.

There were many other able tuberculosis workers in the early days, but space permits mention only of Dr. J. A. Villemin, a copatriot of the eminent Pasteur. He was born in 1827, a year after the death of Laennec, and during the course of his active life he published seventeen important works on tuberculosis, which he believed to be caused by a living agent, a germ which was later to be discovered by Robert Koch. As usual, a good many physicians took pleasure in disagreeing with Villemin, some of them as violently as possible. Villemin, nevertheless, laid much of the foundation of the modern knowledge of one of the most persistent of plagues.

THE BELOVED PHYSICIAN

Tuberculosis is now recognized to be curable, or at least as capable of being arrested. This fact was discovered largely as a result of the experience of Dr. Edward Livingston Trudeau, who, apparently in the last stages of consumption in 1873, went to the Adirondacks to die, but did not die and lived to exert his beneficent influence on the tuberculosis movement for many years. He found that a life in the open, with proper

rest, nourishing food, and other hygienic attributes was the most effective of medicines.

The open-air treatment of the white plague goes back, however, much further than the experience of Dr. Trudeau. As early as 1808, Professor Nathaniel Bowditch, a celebrated mathematician, succeeded in arresting in himself a case of tuberculosis by living and sleeping in the open air. The son and grandson of Professor Bowditch were eminent physicians who later had much to do with this disease. In 1857 the son, Dr. Henry I. Bowditch, sent a patient to the wilds of Minnesota, and is reported to have admonished him not to be afraid of cold open air as it was the coming treatment. Dr. Vincent Y. Bowditch, the grandson, was instrumental in the establishment in 1890 of the Sharon Sanatorium near Boston, the first institution of its kind to be opened near a large city, without regard to climatic conditions.

Dr. Edward Livingston Trudeau, who was born in New York in 1848, came from a medical family, for his father was a distinguished physician of New Orleans and his mother's ancestors were members of this noble profession in France for many generations. The two sons of Dr. Trudeau also became doctors of medicine.

The first introduction young Trudeau had to tuberculosis was when he was seventeen years old, for in 1865 his older brother died of a rapidly progressive type of this disease. Trudeau nursed his brother and even occupied the same bed with him, without objection on the part of the attending physician, who not only gave no advice as to precautions, but would never allow the patient to have a window open. Dr. Trudeau writes of this in his famous autobiography, "How strange

that, after helping stifle my brother and infect myself through such teaching as was then in vogue, I should have lived to save my own life and that of many others by the simple expedient of an abundance of fresh air."

The second introduction to the white plague came in 1873 when the now Doctor Trudeau visited one of his former teachers, the eminent Dr. Janeway and was advised that he was an active case of the disease. Trudeau had graduated from the College of Physicians and Surgeons in New York some two years previously and immediately thereafter had married. He had set up in practice, first on Long Island and later in New York City, though like all beginners he had not been overwhelmed with patients. When his misfortune was revealed to him Dr. Trudeau sought health in the south, but without success.

Faced with the fate which had been his brother's, Dr. Trudeau decided to go off to the mountains, for he loved the forest and its wild life, and the Adirondacks, which was his destination, was then a rugged and somewhat inaccessible region. He insisted upon waiting, however, until his second child was born in May. A week after that event he set out with his friend, Louis Livingston, as sole companion. He expected to find peace in the wilderness and probably eternal rest.

INTO THE WILDERNESS

After a hard and fatiguing journey, Livingston and Trudeau reached Paul Smith's, a haven among the pines. In spite of his gloomy forebodings, once the patient came under the magic spell of the mountains and forest, he decided that he would have to live.

"How little I knew," he has written, "as I shook

hands with the great, strong men who came up to my room that evening to say a word of cheer to me, that forty-two years later most of them would be dead and that I should still be in the Adirondacks and trying to describe my first arrival at Paul Smith's as an invalid."

The Adirondacks did wonders for Dr. Trudeau that first summer. Rest and fresh air, the presence of congenial companions, such as the Livingstons and E. H. Harriman, together with an indomitable spirit, rebuilt what had been a human wreck. The return to civilization in the fall and a winter in St. Paul undid all the good, however, so that a retreat to Paul Smith's in the following spring was necessary. This time Dr. Trudeau took his family with him despite criticism that it was too rough a place for them. They thrived, but Trudeau did not do so well this time, for the disease had made serious inroads.

That winter Dr. Trudeau decided to do the unheard-of thing and stay at Paul Smith's, keeping his family with him. In this determination he was supported by Dr. Alfred Loomis, who had also urged one of his own patients to remain, even though a winter in the Adirondacks in those days was considered somewhat comparable to a sojourn in the Klondike. Paul Smith and his wife had to be won over to the proposition, but finally gave their consent. Dr. Trudeau's mother, who had been living in France for some years, also joined him for several weeks about this time.

Dr. Trudeau took his mother to Malone in January for her departure. His family, which had been visiting in New York, joined him there and they prepared to return to the camp. A blizzard came up, however, and so they deferred the start. When they did set out that

afternoon, under the guidance of the redoubtable Paul Smith, they were able to proceed only fourteen miles to Duane, and then only under fatiguing hardships through deep drifts of snow. At one place the entire party had to be cached in a cave in a snow-drift while the guides broke open the road.

The next day was twenty below zero, with a twenty-eight-mile journey before them. The sleighs were constantly upset in the drifts during their progress and when still three miles from home, the horses gave out. New ones were secured from a neighboring farmhouse, and the trip was completed, three days after it had been begun. Such was life in the wilderness in 1875. Trudeau suffered no serious ill-effects from this trip but his health did not improve during the following summer. He decided to remain another winter, again with the sanction of Dr. Loomis, who frankly had not expected to find his patient alive when he returned after the first winter.

SARANAC

Saranac Lake is now one of the world's most famous health resorts, but in 1876 the village consisted only of a saw-mill, a small hotel, a school, and half a dozen houses. In that year Dr. Trudeau and his family moved to Saranac and spent the rest of his life there, though he went back to Paul Smith's every summer. Dr. Loomis sent a few pulmonary cases to Saranac to get the benefit of the climate and put them under the care of Dr. Trudeau. This was the beginning of Saranac as a health resort and of Dr. Trudeau as a noted physician. A private sanatorium, the first in the United States, had already been established at Asheville, North Carolina, in 1875.

Most of the patients who were able to spend time in the Adirondacks were richer in money than in health. Dr. Trudeau was soon impressed with the desirability of making available accommodations where poor persons could receive care. This idea originated with him in 1882 after he had read an English medical journal containing a description of the Brehmer Sanitarium in Silesia and the value of rest and fresh air in the treatment of tuberculosis. Dr. Loomis readily espoused the plan and Trudeau set about raising the necessary funds.

Many of the wealthy persons who summered at Paul Smith's made donations, as Dr. Trudeau had already built up a practice among them and the kindly and altruistic traits of this gentle physician were everywhere respected. The land for the proposed sanatorium was bought by the guides. A fund of $3,000 was assembled and a business man named D. W. Riddle, who was in the mountains for his own health, became treasurer.

The site selected for the sanatorium was a sheltered place overlooking the mountains. It had been the doctor's favorite fox runway and his guide was much disgusted by the proposal to spoil a perfectly good hunting-ground by putting a building on it. The plans called for a central edifice with cottages for the patients, so that they might be segregated. Late in the fall of 1884 a portion of the main building was completed and Dr. Loomis sent the first patients, two sisters in wretched health and poorly clad, whose travel expenses had been paid by some benevolent person.

The first cottage was finished in February, 1885. This slender building, affectionately known as the "Little Red" is now used as a museum. It was the pioneer in the development of the cottage sanatorium treatment

of tuberculosis in America and is a deservedly precious relic. When Dr. Trudeau's autobiography was published in 1916, the sanatorium was composed of twenty-six cottages in well-kept grounds, with administration buildings, laboratories, infirmaries, nurses' home, and other buildings. There was also a stone chapel, for Dr. Trudeau was a deeply religious man and had been instrumental in the erection of the Episcopal Church of St. John's in the Wilderness at Paul Smith's and of the little chapel at Saranac dedicated to St. Luke, the beloved physician, who was no more saintly or beloved than was Dr. Trudeau himself. St. John's was destroyed by fire in December, 1928, with the irreparable loss of a group of memorial windows given by his friends in memory of Dr. Trudeau. The church has, however, been rebuilt of native stone.

The sanatorium had been going on only about two years when it received a distinguished patient in Robert Louis Stevenson, who remained from October, 1887, to April, 1888. While in the Adirondacks for his health, Stevenson, who later died in the South Seas of tuberculosis, wrote some of his notable essays and also part of his "Master of Ballantrae." Trudeau relates how the famous author came one day to his laboratory but escaped as soon as possible, because, as he said, "Your light may be very bright to you, but to me it smells of oil like the Devil."

Trudeau has written in his autobiography of Stevenson, "To a temperament like Stevenson's, who shrank from the cruel and inexorable facts of life-disease, suffering and death—which were part of my daily existence, and who lived in an ideal world painted and peopled by his own vivid imagination, I represented, I

am afraid, a not very cheerful or inspiring companion. He could not, as I could, look over and beyond these painful associations with which I lived in daily contact at the Sanitarium and the Laboratory, and see, as I did in my ideals, the glorious hope of future relief to humanity from sickness, suffering and death, which lay in the study of disease at the bedside, and of infection, and germs and sick animals in the Laboratory. This was the light which was so bright to me that I never noticed the smell of oil which overcame Stevenson."

This passage reveals the ideals and altruism of Dr. Trudeau, who was not only to see, but personally to experience, much sorrow and suffering, calamities which he always bore with fortitude and a true Christian spirit which many of us might do well to emulate in times of travail. This passage was not a criticism of Robert Louis Stevenson, for he and Trudeau were great friends, but it was an expression of the latter's highly commendable philosophy.

It may have been that Stevenson had in mind Dr. Trudeau when he wrote this eulogy of the physician, "There are men and classes of men who stand above the common herd, the Soldier, the Sailor, and the Shepherd not infrequently; the Artist rarely, rarelier still the Clergyman, the Physician almost as a rule. He is the flower (such as it is) of our civilization; and when that stage of man is done with, and only remembered to be marvelled at in history, he will be thought to have shared as little as any in the defects of the period, and most notably exhibited the virtues of the race. Generosity, he has such as is possible to those who practice an art; never to those who drive a trade; discretion

tested by a hundred secrets; tact tried in a thousand embarrassments; and what are more important, Herculean cheerfulness and courage, so it is that he brings air and cheer to the sick room. . . ."

KOCH AND THE TUBERCLE BACILLUS

Although tuberculosis had been suspected by some scientists of being a communicable disease, this fact was not proved until 1882, when Dr. Robert Koch announced his discovery of the germ of the disease, on which he had been working for about three years. These experiments by Koch were marvellous in their thoroughness, for he checked and rechecked every step in his investigation over and over again.

Koch began his studies with a corpse of a man who had recently died of consumption. He inoculated rabbits and guinea pigs with pieces of tubercle from this man and while waiting for the disease to develop, set out to locate the bacillus with his microscope. He tried all kinds of stains for it until finally he found a dye which caused the microbe of tuberculosis to stand forth in bold relief under his microscope. Then he went back to his animals, which had contracted the disease, and in them he found this same germ.

The bacillus was even cultivated outside of living things by Koch, who devised for it a special food, his famous blood culture, a sort of jelly made with blood serum. On this media he grew germs taken from many different animals suffering from tuberculosis, though only from the sick could he get them. When he injected these bacilli into healthy animals, they promptly came down with tuberculosis. He even sprayed the germs into a big box containing animals, who breathed

these bacilli and contracted the disease as a result. All of this he reported to the Physiological Society in March of 1882.

Koch's paper on the cause of tuberculosis made a tremendous impression on Dr. Trudeau. A friend who was a medical publisher had it translated for him and Trudeau read it over and over again. He was strongly convinced of the soundness of the deductions and determined to learn something about bacteriology. On his next trip to New York he visited Dr. T. Mitchell Prudden at the College of Physicians and Surgeons and haunted the gloomy laboratory until he had become fairly proficient in staining the bacillus so that it could be seen under the microscope. He spent three days in this laboratory, with hardly time out for sleep, staining everything in sight, including much of himself.

This newly gained knowledge soon proved its value. In the summer of 1885 a young college student came to Saranac intending to consult Dr. Loomis about a persistent cough. In the absence of this physician, he came to Dr. Trudeau, who took a sample of the patient's sputum and subjected it to a microscopical examination. The result was positive, but the big strong man refused to believe that he could possibly have consumption and Dr. Loomis, who had as yet had no faith in such new-fangled notions, could find nothing wrong after an intensive physical examination. The patient returned to college, but soon after had a severe hemorrhage and other unmistakable symptoms of tuberculosis. Other cases confirmed the value of the sputum examination, which is, of course, to-day one of the routine tests.

Brilliant as were Koch's experiments, the medical

profession was slow to accept the idea that consumption is communicable. Not until 1889 was this fact recognized by any health authorities, but in that year the New York City Health Department issued a circular on "Contagious Consumption," which gave rules for preventing the spread of the disease. The suggestion for this leaflet came from Drs. H. P. Loomis, T. M. Prudden, and H. M. Biggs. It was 1897, however, before pulmonary tuberculosis was made reportable by physicians and institutions, and all forms of the disease were not required to be reported to the health officials in New York until 1907. This shows how long it takes to achieve practical application of the discoveries in the field of preventive medicine.

THE LABORATORY

In a corner of the house which he had built in Saranac Lake in 1883, Dr. Trudeau established his laboratory two years later, and this event was almost as important to the anti-tuberculosis movement as was the founding of the sanatorium. This laboratory began like all those which have since attained real greatness, in the most humble and modest circumstances. At first it was only a small room, but soon an addition to the house had to be constructed for the enthusiastic investigator. This was Dr. Trudeau's workshop during the next ten years, until it was destroyed by fire in 1893. The little laboratory was the precursor of the modern, elaborately equipped institution which now graces this section of the Saranac Laboratory for the study of tuberculosis.

At about the same time when the already eminent Pasteur in France was making his famous studies on

rabies and inoculating rabbits with the disease, so that he could procure an attenuated virus, Dr. Trudeau, still a somewhat obscure country physician, was conducting a different kind of experiment with rabbits. He was seeking to ascertain the effect of environment on the development of the bacillus of tuberculosis, and for this purpose used three groups of five rabbits, each of which was subjected to different conditions, similar to those often experienced by human families.

The first lot of rabbits was inoculated with pure cultures of the germ and then placed under the best possible conditions, with abundant food and ample fresh air and sunshine. All, with one exception, recovered. The second lot, inoculated at the same time in the same manner, were placed in dark, damp surroundings, with bad air and insufficient food. Four of the five died of tuberculosis. The third lot were not inoculated, but kept in an environment similar to that of lot 2. None showed any tuberculous disease, though they became emaciated as a result of their unfavorable surroundings and mode of living.

This experiment demonstrated the effect of environment on the development of tuberculosis and Dr. Trudeau was invited to present a paper embodying his results and observations before a scientific society in Baltimore. It was his first attempt at this kind of public appearance and he relates that when the time for his presentation arrived, he fainted, and Dr. Loomis had to read the paper for him.

One constant quest at the laboratory was that for a specific cure for tuberculosis. None has ever been found, however, except the combination of rest, good food, and fresh air and sunshine. In 1890, the great Dr.

Koch announced that he had discovered a remedy, but after some months' trial his substance failed to effect any miraculous cures, though this medicine, made of boiled glycerine extract of the tubercle bacillus, called tuberculin, did have its uses. Dr. Trudeau was never able to immunize his guinea pigs with it, nor has any other investigator. Recently Dr. A. Calmette at the Pasteur Institute in Paris has had some success with a vaccine which he has developed. More than 100,000 children have been vaccinated with this B. C. G., as it is called, and good results have been obtained, though in 1930 it was the consensus of scientific opinion that further study of this procedure is needed.

SUNLIGHT AND HEALTH

While no drug which will cure tuberculosis has been found, and most of the serums developed have had indifferent success until lately, there is one therapeutic agent which has long been recognized as possessing definite curative effects on certain forms of tuberculosis, as well as on other diseases. That is sunlight, nature's oldest contribution to the promotion of health. It was used by the medicine men of ancient Egypt in the days of the Pyramids; it was in the materia medica of Hippocrates in the Golden Age of Greece, and the Father of Medicine built a temple to the sun by the blue Ægean Sea. There the healing art was practised with the aid of the sun, though without the knowledge of vitamin stimulation, which is due to the effect of the sun's rays.

The pioneer in the modern development of the scientific use of heliotherapy was a young Danish physician, Niels R. Finsen, who published results of a study on

this subject in 1893. To be sure, others had previously delved into this problem and a French doctor, M. Bonnet, had recommended the sun in the treatment of tuberculosis as early as 1845. Dr. Koch had also noticed that sunlight exerted a germicidal effect on the tubercle bacillus which he had discovered. Finsen was the first to apply this theory, however, and he definitely proved that lupus, or tuberculosis of the skin, would yield to the action of sunlight. He disclosed the fact that it was the ultra-violet light of the sun, the invisible rays at the end of the spectrum which produced the beneficial effect, and he constructed a carbon arc lamp to duplicate these precious rays. The researches of Dr. Finsen were, as customary in such cases, unappreciated for a long time, but recognition came finally and he was awarded the Nobel Prize in Medicine shortly before his untimely death in 1904.

One high priest of the modern sun cult is Dr. Rollier of Switzerland. In 1903 this physician went to Leysin in the Alpes Voudoise and there began the systematic use of sunlight in the treatment of tuberculosis. Today the *Ecole au Soleil* which he established in 1910 is celebrated the world over and has been the model for numerous other similar institutions. Rollier positively demonstrated that sunlight would cure bone and glandular tuberculosis, while later studies have shown it to be efficacious in the treatment of rickets, osteomyelitis, and many other conditions.

Sun worship is part of the regimen of every sanatorium now. At Saranac in the middle of winter, it is no uncommon sight to see groups of happy children playing naked in the snow. Heliotherapy was first used in the country at the J. N. Adam Memorial Hospital at

From "E. L. Trudeau, An Autobiography." Doubleday, Doran & Co.

DR. TRUDEAU

Perrysburg, New York, and has since been employed everywhere. When sunlight is not available the quartz lamp is a substitute, though no imitation ray quite equals the natural.

A place in the sun is by no means reserved only for those suffering from tuberculosis. This most inexpensive of remedies is generally available for all, and a coat of tan is to be looked upon as one badge of health. The ultra-violet rays which possess the health-giving power comprise only about one per cent of all the solar spectrum and they are easily filtered out by smoke, dust, and moisture. A city which allows the belching of black smoke is wilfully and wantonly obstructing the promotion of the public health. The ultra-violet rays are also intercepted by ordinary window glass, but will pass through special glass made of quartz, and already such glass has been put on the market by enterprising manufacturers.

Light, as John Milton once said, is necessary to life and is almost life itself. Wisdom bids us, as modern Zarathustrians, to go back to sun worship as a hygienic measure. Let us return to the days of Ra and Shamash and Helios, old gods who were givers of light and of health and life.

LATER DAYS AT SARANAC

As time went on fame came to Dr. Trudeau and the sanatorium grew and prospered. The wealthy people whom he had cared for at Paul Smith's and others who witnessed the untiring devotion of this sick man for his patients and charges were inspired to make contributions or donate new cottages. A great sorrow also came to the Trudeaus when in 1893 their daughter

died suddenly of tuberculosis after an illness of several years. She was buried from St. Luke's Church, with Paul Smith, his two grown sons, and many of the guides as pallbearers.

When his house and laboratory were burnt, Dr. Trudeau lay ill in a New York hotel. Dr. Loomis brought a telegram from Trudeau's assistant, Dr. E. R. Baldwin, but advised Mrs. Trudeau not to tell her husband, as he was too sick. She replied that she had never kept anything from him and went to inform him. He knew from her attitude that something had happened and was fearful that his son Ned had been killed. When she informed him that the laboratory had been destroyed, he breathed a sigh of relief and remarked that they could get another house.

His friend, Dr. William Osler, wrote that he was sorry to hear of the loss, but he said, "there is nothing like a fire to make a man do the Phœnix trick." As Trudeau tells, hardly was the ink dry on Osler's letter before a new laboratory was assured, for a friend, a Mr. George C. Cooper, came to him and with much embarrassment told him to build a new laboratory, for which Mr. Cooper would pay. This new stone edifice was opened in 1894.

Another tragedy occurred when the Trudeaus lost their son, Ned, who had just begun a promising medical career in New York in association with the late Dr. W. B. James. It was then that the love of his friends was manifested. Mr. Harriman arranged for two special cars to carry the body home with its party of mourners. At the church at Paul Smith's all the ground had been covered by green boughs and flowers. A few days after the funeral when Dr. Trudeau started

out to collect and settle the bills, he was met everywhere with the same answer, even from the poorest hackman, there was no bill. This was the least tribute they could pay to their benefactor.

A NATIONAL MOVEMENT

Atlantic City in June of 1904 was the scene of a new and much deserved triumph for Dr. Trudeau. During the convention of the American Medical Association, a meeting was held to organize a national society to fight tuberculosis. Trudeau's name was proposed as the first president and he was elected by unanimous acclamation. Due to his usual modesty, Dr. Trudeau declined the honor, but Dr. William Osler and Dr. Henry Barton Jacobs seized him by the arms and marched him, protesting and flustered, to the platform, where he was greeted by thunderous and prolonged applause.

To-day the National Tuberculosis Association is the largest and most influential of the many voluntary health agencies in this country. It has affiliated state societies in every state, and there are more than 1,200 local tuberculosis associations. Its members comprise not only professional tuberculosis workers and physicians, but also laymen who are interested in this phase of public health. The many distinguished presidents of the National Tuberculosis Association have all been physicians, with one exception, Mr. Homer Folks, a social worker who was elected in 1912.

CHRISTMAS SEALS

Every year at Christmas time there appear millions of little stamps bearing the red cross of Lorraine,

which convey a message of health and good cheer on letters and packages. These Christmas seals are important in many ways. Not only do they make the sender and recipient each think of good health, always worth thinking about, but their sale provides practically all the money which supports the non-governmental onslaught against tuberculosis.

The Christmas seal has now been used for over twenty years. In 1907 Jacob A. Riis received a letter from a friend in Denmark which had affixed to it an interesting seal. He wrote to his correspondent and asked about this device, which had been used in the Scandinavian countries in connection with tuberculosis activities since 1903, having been suggested for this purpose by a Danish postal clerk. Mr. Riis then wrote an article about the seal for *The Outlook.* The article was read by Miss Emily P. Bissell of Wilmington, Delaware, who was interested in a tuberculosis camp on the Brandywine.

"Why not raise funds to fight tuberculosis, by means of Christmas seals?" asked Miss Bissell and thereupon proceeded to do so. Howard Pyle, the artist, designed a seal for her, and the local newspapers, particularly *The Philadelphia North American,* gave her their support. The result was a comfortable sum for the camp. Then Miss Bissell went to the headquarters of the American Red Cross at Washington and suggested a National Christmas seal sale. Such a novel idea did not then impress the officials of this body at all. Miss Bissell was insistent, however, and even offered to finance the first year's sale herself. So they tried it.

The first nation-wide sale of Christmas or Red Cross seals in 1908 brought in $135,000. The next year's

sale saw $200,000 raised. In 1926 the amount was well in excess of $5,000,000. Of this sum 95 per cent is used in the states where it is collected and only 5 per cent goes to the national organization to maintain its staff of 50 and their many activities. The seal sales were under the auspices of the Red Cross, cooperating with the tuberculosis societies, until 1920 when they were taken over entirely by the National Tuberculosis Association and the doubled-barred cross of Lorraine superseded the red maltese cross of Geneva on the seals.

TRUDEAU'S MONUMENT

After 1904 Dr. Trudeau's health failed rapidly, though he continued to look after patients and to promote the welfare of his sanatorium. Many substantial gifts were made in these years and the institution grew rapidly. Many physicians who are famous to-day were connected with the sanatorium or the laboratory for varying periods. Many patients clamored for admission, but only those with incipient cases for whom there was hope of recovery could be accepted.

The twenty-fifth anniversary of the opening of the sanatorium was celebrated with appropriate ceremonies in 1910. Several hundred friends and former patients assembled for the festivities and heard Dr. Trudeau tell them modestly of his struggles and his accomplishments.

"I had an unlimited fund of enthusiasm and perseverance," he said in referring to the many early discouragements, "and I had faith; that kind of faith that sees the goal and is blind to the obstacles; faith in myself; faith in my power to do something, no matter how little, for a good cause; faith in my friends—and

that faith has been reflected on me so that they have poured their money into my lap all these years for my work; faith in the future, here and hereafter."

Dr. Trudeau died in 1915. Near the entrance to the sanatorium his many friends have erected a monument to his memory, which was unveiled in 1918. It represents a seated figure, wrapped in a blanket. It faces the mountains he loved so dearly and the golden sunlight of the glorious Adirondacks illumines it with a glamour which seems spiritual. On the marble pedestal of this statue are inscribed in French the words,

"To cure sometimes, to relieve often, to comfort always."

This is but one of the monuments to Dr. Trudeau, the beloved physician. Another is the splendid institution which has given hope and health and life to so many of the supplicants of humanity. That is a much greater monument, but the most exalted memorial of all is the universal love and respect which he inspired in his fellow men and the example which he gave to them. No greater glory than that can exist in this world.

IX

SEDGWICK AND THE GOLDEN AGE IN PUBLIC HEALTH

PUBLIC health has its sleuths, scientific detectives who unravel the mysteries of epidemics. They trace with consummate skill the causes, or etiology, of outbreaks of disease. Like members of the police they are always on call, ready to rush to the scene of any emergency and by means of observation and analysis, skill and experience, logic and deduction, ascertain who is the perpetrator of the crime which has been committed against society. The malefactor may be man as a human carrier, or it may be milk, food, an insect, or some other agency. It is the job of the epidemiologist, or sanitary detective, to find out, and to take steps to avert further disaster.

William Thompson Sedgwick was the greatest of all sanitary detectives, though his fame securely rests on his many other accomplishments for public health as well as on his dexterity as an epidemiologist. When Sedgwick crossed the threshold of sanitary science, the golden age of public health began. It was the golden age because this period, at the end of the nineteenth century and the beginning of the twentieth, was marked by many new discoveries, and also by a remarkable application of the new principles of preventive medicine made available by the genius of the immortal Pasteur and his contemporaries. There never has been another period so notable in public health, and the record of the two decades from 1890 to 1910 may, perhaps, never

be equalled again. Much of the brilliance of the times was due to the inspiration and personality of Sedgwick, though there were also many other noteworthy figures during the period.

When Sedgwick graduated from Yale in 1877, Pasteur had just given to the world his first paper on anthrax. When Pasteur died in 1895, Sedgwick, who was born in Connecticut on December 29, 1855, was already the acknowledged leader of public health in America. Throughout the remainder of his life he was the foremost exponent of sanitary science, for as epidemiologist, teacher, practical biologist, and public servant, his beneficial influence on our national vitality was not transcended by that of any of many lustrous contemporaries.

Renown comes to some because of spectacular rather than notable achievements. Gorgas, for instance, received acclaim and well-deserved popularity because of the conspicuous accomplishments which fate made possible for him. Great as was Gorgas, Sedgwick was an even greater man because of his persistent and enduring influence on public health. This is not heresy, nor is the assertion any disparagement of the attainments of the celebrated conqueror of yellow fever in Panama. Facts, however, speak for themselves.

Beyond the circle of his own profession, which will always revere his name, Sedgwick was little known to the public. He was a familiar figure in Boston where he taught, but Boston is not the universe, even though it be the hub. Sedgwick was, nevertheless, the "pioneer of public health," as three of the most distinguished of his many illustrious pupils have called him.* He came

*E. O. Jordan, G. C. Whipple, and C.-E. A. Winslow: "A Pioneer of Public Health, William Thompson Sedgwick," 1924, Yale.

to the field at a time when the seeds of sanitary science had only just been sown. It was he who nourished and garnered the crop so that to-day you and I are enjoying the fruits of his labors in such tangible forms as pure water, proper waste disposal, a comprehension of how diseases spread, and an appreciation of hygiene and sanitation. Sedgwick was not, of course, the only great sanitarian of the day, for the chronicles of the times resound with the names of Biggs, Chapin, Welch, Vaughan, Winslow, Park, Ashford, Stiles, Trudeau, Reed, and Gorgas, to mention only a few.

THE RÔLE OF THE PIONEER

"Human life," Sedgwick wrote early in the twentieth century, "was probably never more interesting or more exciting than it is to-day. Those of us who were born in the middle of the last century have been sufficiently fortunate for we have witnessed the conquests of Darwinism and the theory of evolution, the rise of anthropology and the rise and victories of the germ theory of disease. Think of it for a moment. The theory of gravitation, the theory of evolution, the theory of infection. What a privilege to have lived while these were debated and finally accepted as the basal theories of science. And yet those who are now coming on the stage are likely to enjoy lives even more interesting, for not only will new knowledge arise and new theories press forward, but the application of the knowledge already in hand will of itself suffice for many lifetimes."

When Sedgwick strode upon the stage in 1880 to assume his rôle as a biologist and a teacher, Pasteur was just beginning to prove that it is within the power of man to vanquish the microbic diseases which inflict

humanity. Miss Nightingale had then about finished her work in behalf of the sanitation of hospitals, Lister was at the height of his fame, and Trudeau had lately gone to Saranac. A few years previously, in 1865, Dr. Stephen Smith had made a sanitary survey of New York City, a study which had focussed attention on certain parts of this metropolitan area as a breeding place of preventable diseases. Due in considerable measure to the efforts of Dr. Smith, the sanitarians of the time had formed in 1872 a professional society, the American Public Health Association, and a short-lived national board of health had been set up by Congress in 1879. In Massachusetts the first state health department was functioning, though not as yet in a fully effective manner. The stage was set, only the hero was needed.

William Thompson Sedgwick had intended to embark upon a medical career after he graduated from the Sheffield Scientific School at Yale in 1877. In fact, he did enter the medical school, but circumstances arose which diverted him to biology and a "Ph.D." instead. There is little wonder that the more honorable degree of those days appealed to him, for medical education of the seventies was vastly different from its modern excellence. Most of the subjects were taught entirely by lectures, such as they were, the expositors often being none too well versed in the sciences which they endeavored to elucidate. Sedgwick himself has written that his instructor in surgery, a busy practitioner, evinced a skeptical, though open-minded, attitude regarding Lister's antiseptic methods, then ten years old.

The opportunity to change came to Sedgwick in 1879 when he and his intimate friend, E. B. Wilson, were

awarded scholarships at the newly established Johns Hopkins University. "Men, not buildings" had been the slogan of President Gilman in gathering together his remarkable faculty, a group which attracted many students who were later to become leaders in various fields. Not the least brilliant were the graduates in biology, taught and inspired by Professor Martin, himself a disciple of Huxley. Sedgwick gave up all ideas of becoming a practitioner of medicine, served under Martin as fellow and instructor from 1879 to 1881 and received his degree in 1881. In the same year, on his twenty-sixth birthday, he married Mary Katrine Rice of New Haven. A doctorate in philosophy and an uxorial connection within one sidereal is a distinct achievement for any man.

AN ENGINEERING SCHOOL SHOWS THE WAY

Public health efforts have always been considered by the medical profession as one of their inalienable prerogatives. Yet it was not a medical school, but an engineering institution which took the initiative in offering the first real instruction in public health in this country. Not many medical schools give much consideration to public health even to-day, for that matter, and more trained sanitarians have so far been bestowed on the United States by this same school of engineering than by all of the other medical schools of public health combined.

In 1883 General Francis A. Walker, president of the Massachusetts Institute of Technology, asked a former student of his at Yale to come to Boston and take a chair as assistant professor of biology at the Institute. That former student who had so impressed the doughty old general was Sedgwick. He arrived in Boston when

the new "Tech" had been in operation less than twenty years, and he found only a score of faculty members and slightly over 400 students. Without endowment or resources, with no hallowed traditions, tolerated rather than encouraged, as Sedgwick once declared in later years, the Massachusetts Institute of Technology was already becoming a potent factor in industrial and engineering America. It had a way of training men, men who made their mark. It had already conferred a president on Harvard, for Charles W. Eliot was professor of chemistry at the Institute when the older and more venerated university across the Charles River chose its greatest president. Eliot was to be, as Sedgwick has written, the Martin Luther of medical education in the United States, for he vigorously proceeded to reform it at Harvard.

With the advent of Sedgwick, the engineering school was destined to assume a position of importance in public health. At first the new Department of Biology attempted to assuage the crying need of pre-medical education by offering courses in physics, chemistry, and biology, as well as other essential subjects, to those intending to study medicine. Prospective physicians of those days apparently considered a complete and liberal education unnecessary or an incumbrance, however, for they ignored and eschewed Sedgwick's admirable courses.

Having been rebuffed by the embryonic medicine men of the times, the Department of Biology of the Massachusetts Institute of Technology soon found an outlet for its energies. Its functions were broadened to provide knowledge not only for those future physicians who would condescend to enter upon that noble profes-

sion with some fundamental knowledge, but for those who wished to use biological attributes in connection with the duties of boards of health and other sanitary work, as well as in its industrial applications. This broadening of scope was still further enhanced by the scintillating discoveries in the field of bacteriology which were then illuminating the scientific horizon.

When Sedgwick went to Boston, the germs of disease were being discovered right and left. Pasteur had shown the way and his rival, Koch, was assiduously trailing the various elusive bacteria to their lairs. In 1882, after several years of hunting, he found the tubercle bacillus, and in the next year that of cholera and also the germ which causes conjunctivitis, an eye disease. In 1880 Koch and Eberth, working independently, had isolated the typhoid organism, while the malarial parasite was discovered by Laveran in that same year. Between 1877 and 1887, in fact, more than twenty different germs were recognized for the first time and the doors were opened wide to an onslaught upon these invisible enemies of mankind. As Harvey Cushing has said in his admirable biography of Osler, "new discoveries were being announced like corn popping in a pan."

In this momentous period, Sedgwick was abreast of the times. He would have liked to go to Europe and study under the ægis of Pasteur or the forbidding Koch, but unable to enjoy this privilege, he sent to the latter for a batch of his newly devised nutrient gelatin for growing bacteria. This solid media was brought back to Sedgwick by his colleague, Professor William Ripley Nichols, of the chemistry department of the Massachusetts Institute of Technology. The eminent

chemist was inclined to scoff at such new-fangled elusions as microbes and he handed the gelatin to Sedgwick with a chuckle, for, not realizing its physical properties, he had allowed it to melt and ooze out of the flask. Thus by contamination, the first batch of culture media to reach this country, had become an infected and malodorous mess. No wonder, as Sedgwick delighted in telling his later classes, the doubting chemist was a little scornful of this somewhat inauspicious beginning of bacteriology at the Massachusetts Institute of Technology.

Though one of the first to teach and practise bacteriology in America, Sedgwick was not the only pioneer in this budding science. In 1878 a young physician named William H. Welch, now affectionately known to a host of mature and bearded physicians, whom he has instructed and inspired, as "Daddy Welch," was experimenting with bacteria at the Bellevue Hospital Medical College in New York, while near by Dr. T. Mitchell Prudden was doing the same at the College of Physicians and Surgeons. An army surgeon was the most notable of the pioneers, however, for in 1878 Dr. George M. Sternberg of the Army Medical Corps began extensive investigations on disinfectants, studies which involved a skilful bacteriological technique. In 1880 he went after yellow fever and though he failed to find the causative organism, did prove that each of a large number of germs which had been accused of being the infecting agent of this disease were actually not guilty. It was Sternberg who, when surgeon-general of the army, appointed the famous Reed Commission which finally revealed the secret of the transmission of the scourge of the tropics.*

*See Chapter VII.

Others there were, too. While Welch and Prudden and another future notable named Biggs in New York were going after the bacteria which cause diseases of man, the organisms responsible for maladies in animals were being studied by Dr. D. E. Salmon of the United States Bureau of Animal Industry. Out in Michigan Dr. Victor C. Vaughan and his assistant, Dr. Novy, were also getting inquisitive about these bacteria and endeavoring to enlighten eager students concerning them. Like Dr. Welch, who is a confirmed bachelor, Dr. Vaughan, was another who was honored by his former pupils with the friendly and respectful title of "Daddy." Sedgwick was always known as the "Chief." When a great teacher is dubbed with an endearing and enduring nickname, then he has achieved true human eminence.

The laboratories of nearly all of these early microbe-snarers were in or connected with medical schools. Sedgwick's position was unique in that his sanctum was in an engineering institution, devoted primarily to such apparently more utilitarian subjects as mechanics and structures, bridge design and hydraulics, entropy and electrolysis, architecture and similar topics. In a few years, however, the practical and material advantages of a knowledge of public health were so well recognized that in 1888 Sedgwick was called upon to give his eloquent lectures to all of the engineering students, whether civil, mechanical, chemical, electrical, or of any other breed. In 1889 a course in sanitary engineering, the first in this country, was established at the Institute.

SEWAGE AND SENTIMENT

Sewage would hardly appeal to the person of æsthetic tendencies as susceptible to sentiment or romance. In

1886, however, the Commonwealth of Massachusetts reorganized its health department, which had previously been concerned with lunacy as well as sanitation, and charged it with making studies on the purification of sewage. At Lawrence there was, accordingly, set up an experiment station, which soon became a veritable temple of sewage. Sedgwick was appointed consulting biologist to the state and his colleague, Professor Thomas M. Drown, became consulting chemist. All of the resources of biology, chemistry, and engineering were invoked to convert sewage from a nuisance into a harmless fluid. The Lawrence Experiment Station was the first institution of its kind in the world and from it emanated most of what we know to-day about the proper disposal of those wastes which are the inevitable accompaniment of civilization.

The experiments at Lawrence were directed by the foremost hydraulic engineer of the day, Mr. Hiram F. Mills, and they were carried out by a group of young assistants, Allen Hazen, George W. Fuller, E. O. Jordan, Gary N. Calkins, X. H. Goodnough, and others, all of whom are to-day among the most eminent of our consulting engineers or distinguished professors. A station for the study of water purification was also established at Chestnut Hill, in charge of George C. Whipple, who was later to become professor at Harvard and a sanitary engineer of international reputation. Another cohort was Ellen H. Richards, who was the founder of home economics. Massachusetts showed wisdom in those days by spending her money on brains instead of buildings.

In a classic volume on sanitary science which he published in 1902, Sedgwick described in glowing language

the construction of the sewage filters. "The results crowned the endeavor," he wrote, for his filters revealed that the organic matters in the sewage were slowly reduced to mineral substances, not by a strainer, but "as wood by a slow fire is turned to ashes." He said that bystanders were amazed and could not repress their feelings of surprise and admiration. To-day sewage can be so treated that the effluent comes forth as clear and pure as the crystal water from a mountain stream. Not all of it actually is so treated, but it can be.

Water and sewage were not the only objects of attack by Sedgwick and his associates and pupils. Many other contributions to public health emanated from the Institute and the laboratories of the state. Among them were an invention for the bacterial examination of air, known as the Sedgwick-Tucker ærobioscope; a device for estimating microscopic organisms in water, the Sedgwick-Rafter method, still in use; studies on gas poisoning by Sedgwick and Nichols; and investigations of the market milk of Boston, the first bacteriological examination of a municipal milk supply ever conducted in the United States. In addition, there was work on ice, cold storage, ventilation, and last, but not least, on typhoid fever. It was a period of glorious achievement in the interests of safer, saner and more sanitary surroundings.

BIGGS THE SANITARY STATESMAN

While this Massachusetts group was concentrating its energies on the environmental factors which influence the public health, the bacteriologists in New York, Prudden, Biggs, Park, and others, were concerned more with microbes in their relation to pa-

thology, that is, to the internal rather than the external aspects of the human body. In 1884 Dr. Welch had gone to Johns Hopkins University to take the chair of pathology, the same year that Klebs discovered the diphtheria bacillus and Gaffky found the germ of typhoid fever. About a year later, Mr. Andrew Carnegie provided funds for a Carnegie Laboratory in New York City, which was directed by Drs. Janeway and Dennis, with Dr. Hermann M. Biggs as instructor.

Sedgwick was the American pioneer in public health, but it was Biggs who by the exercise of statesmanship of a high order, modernized our public health administration.* Hermann Michael Biggs was born at Trumansburg, New York, in 1859, and was educated at Cornell and at the Bellevue Medical College, where Edward Janeway and William H. Welch were then professors. Like Sedgwick, one of his first great accomplishments was as a sanitary detective, for in 1885, shortly after his appointment to the staff of the Carnegie Laboratory, he was sent to Plymouth, Pa., to investigate a severe epidemic of typhoid fever. He found that the initial cause of the 1,100 cases was a single patient whose discharges had been thrown upon the snow and washed into a stream which emptied into the reservoirs of the city.

When cholera was epidemic in Hamburg in 1892, Biggs offered the startling suggestion that bacteriological examinations be made on arriving immigrants in order to detect carriers of the disease. Four years previously he and Prudden and others had been appointed consulting pathologists to the New York City

*See "The Life of Hermann M. Biggs," by C.-E. A. Winslow. Lea & Febiger, 1929.

Health Department, a responsibility in which they did not wait until they were consulted, but fortunately for public health, took the initiative. At the time of the cholera epidemic, New York City established a laboratory, the first municipal institution of its kind in the world, with Biggs as director. A young physician, named William H. Park, was engaged as assistant to perform the novel duties planned. In 1897 Dr. Park became chief of this laboratory, a position he still held in 1930.

A year after Park began his work, New York physicians were agitated by the novel pronouncement that diphtheria would henceforth be diagnosed in the laboratory without even seeing the patient. If cultures were taken by the physician from the nose and throat of the suspected case, the diphtheria germs, if they were there, could be grown on appropriate media, and then the microscope would reveal their presence. Shortly thereafter this laboratory offered to examine sputum for the germ of tuberculosis. Next, in 1895, it began to manufacture the antitoxin which when injected into the individual in the early stages of diphtheria combats and overcomes the toxin or poison produced by the disease. In later years this laboratory in New York has been the leader in developing the Schick test for diphtheria and the use of the toxin-antitoxin which prevents this malady as surely as vaccination averts smallpox.

When Seth Low was elected mayor of New York in 1901 he wanted to appoint Dr. Biggs as city health commissioner, but, though the latter loved public health for the good that this science could do and was doing for humanity, he also wished to continue in the practice of medicine, and so he refused the commissionership,

which went to Mr. Ernest J. Lederle, a chemist. Biggs did assume the position of general medical officer, an office he held for the next twenty-six years, being retained under Tammany and anti-Tammany administrations. At one time he pulled Charles F. Murphy, the big boss, through a siege of typhoid fever, and the word went around in these hectic days before the advent of the so-called "new" Tammany that Biggs and the health department were to be left alone in their glory.

During the tenure of office of Dr. Biggs, New York City established the first municipal tuberculosis hospital in 1905, organized the first city division of child hygiene in 1908 under the direction of Dr. S. Josephine Baker, and by its general efficiency excited the admiration of Robert Koch, who visited Biggs in that year. In 1914, Dr. Biggs was made commissioner of health of New York State, a position held until his death in 1923. He was statesman enough to surround himself with able assistants, including such men as Linsly R. Williams, C.-E. A. Winslow, H. L. K. Shaw, A. B. Wadsworth, and Cressy L. Wilbur. His administration was so successful that he was kept on by every governor, whether Republican or Democrat. If he had not been, sundry political leaders would have heard the threatening voice of an aroused and angered public opinion.

When the World War came, there arrived with it the problem of tuberculosis in France. At the request of the Rockefeller Foundation, Dr. Biggs made a survey of the situation on the ground and recommended a programme which was adopted, with Dr. Livingston Farrand and later Dr. Linsly R. Williams in charge. Dr. Biggs was also one of the organizers of the League of

Red Cross Societies and served for several months as first medical director at the headquarters in Geneva, to be succeeded by Professor Winslow, after a sanitary engineer, Colonel F. F. Longley, had temporarily served as "medical" director.

The last public appearance of this sanitary statesman was in Washington in May, 1923, during a meeting of the National Conference of Social Work held in the D. A. R. Hall. At that time I was associated with the National Health Council, with an office in the American Red Cross, whose headquarters are next to those of the Daughters of the American Revolution. The charts with which Dr. Biggs was to illustrate his address had been sent to me from New York, with the request that I see that Dr. Biggs got them. For some reason they failed to arrive until about fifteen minutes before Dr. Biggs was to speak. I rushed across the street, staggering under the load and breathlessly delivered them to Dr. Biggs on the platform. Much to my disappointment, he had already decided not to use his diagrams, nor, in view of his remarkable presentation, were they needed.

As Professor Winslow has well said in his admirable biography of Biggs, "he found American public health in a state of subjective empiricism, and he left it a solid applied science." He and Sedgwick bequeathed an indelible impression on modern health work, and their achievements have helped in no small degree to make the United States one of the great nations of the earth, great because it can be a healthy nation.

SEDGWICK AS SANITARY DETECTIVE

Sedgwick has been called the Father of Epidemiology in America, because he was the pioneer who laid down

the first standards for the investigation of epidemics. His methods have been followed ever since, that is as closely as they could be, for no one has yet appeared with a personality which could equal that of the "Chief." He was the true gentleman, always courteous, always firm, and his honorable, energetic, and persistent methods of investigation would force the most reticent and unyielding of potential informers to yield.

Like a wolf on the fold, typhoid fever, which had been lurking in the polluted waters of the Merrimac, swept down the valley with terrible intensity in 1890. This great epidemic appeared in the autumn at Lowell, Massachusetts, and then irresistibly surged on to Lawrence, nine miles farther down the river, where Sedgwick was working his miracles in the Experiment Station.

Mr. Mills and Professor Sedgwick were called to the rescue. By the most skilful kind of sleuthing they discovered that the source of pollution in Lowell was a little feeder of the river known as Stony Brook, which entered only three miles above the intake of the water works. A number of cases of typhoid fever were polluting this brook so that the inhabitants of the city were imbibing water flavored with typhoid germs. Lawrence below was getting this same pollution plus all of the sewage of Lowell. Before the epidemic occurred, the people had been perfectly content to drink sewage, but after experiencing some 1,500 cases of a preventable disease, both cities decided to put in filters. Newburyport at the mouth of the river, where there ought to have been an accumulation of infection, already was deriving its water from unobjectionable sources and as a consequence had escaped the epidemic. After Law-

rence purified its water by means of the first scientifically designed filter in the United States, it suffered from no more epidemics of typhoid fever.

During his detective work at Lowell and Lawrence, Sedgwick personally visited some 2,000 houses in order to secure the data he needed. Two years later he performed another feat in tracing a typhoid epidemic in Springfield, Massachusetts, to a totally unsuspected milk supply. He showed that almost every one affected had swallowed milk supplied by a particular milkman. Then by much patient inquiry he established that this milk had all come from a farm, several miles from the city, where there had lately been a case of typhoid fever. This patient's excreta had contaminated the milk, which was consumed raw by the customers of the milkman. Sedgwick was one of the first to advocate pasteurization of milk, a system which is now required in all of the more progressive communities.

Another remarkable piece of sanitary detective work which deserves mention was the exploit of Professor H. W. Conn in 1894 in tracing an epidemic of typhoid to raw oysters eaten by college students at a fraternity banquet in Connecticut. Thirty-two years later another epidemic of the same disease in New York and Chicago was traced to a similar source, with the result that oysters suddenly became rather unpopular. To-day sanitary engineers of the Public Health Service are busy certifying the succulent bivalves so that hungry epicureans may consume them with impunity. Professor Conn was not only an oyster expert in his day, but he did the first work on the bacteriology of milk. In 1899 he served as secretary of the Society of American Bacteriologists, founded in that year, with Sedgwick as president.

Each disease has had its particular Nemesis. Anthrax and rabies succumbed to Pasteur, tuberculosis yielded to Trudeau, yellow fever lost to Reed, diphtheria submitted to Park, hookworm surrendered to Stiles. The list might be continued for many other morbidities. The subjugation of typhoid was Sedgwick's especial forte. In 1892 he was the first, for instance, to call attention to the rôle of flies in conveying the germs of this disease, a fact which was later reaffirmed by Dr. George M. Kober in Washington, D. C., and by Drs. Reed, Vaughan, and Shakespeare during our war with Spain. Sedgwick also pointed out the dangers of contact infection in typhoid, as he ran down one epidemic in which this means of dissemination played its part.

In later years (1906–1909) Sedgwick was closely concerned with a four-years' study of typhoid fever in the State of Washington, conducted by several officers of the United States Public Health Service. He had been appointed to the Advisory Board of the Hygienic Laboratory of this federal bureau in 1902 and served in that capacity until his death. He was also an assistant surgeon-general in the reserve of the Service and was always an ardent supporter of our principal national health agency. A number of his students have held responsible positions with the Service and have contributed much to its progress and welfare.

UNHOOKING THE HOOKWORM

Sedgwick was not the only acquisition of the United States Public Health Service in 1902, for in that year this bureau was fortunate in placing on the staff of its Hygienic Laboratory a young zoologist named Stiles.

Dr. Charles Wardwell Stiles had already made a name for himself by discovering the *Necator americanus,* sometimes also called the *Uncinaria americana*. Translated into the language of the layman, these sesquipedalian titles merely signify the American Hookworm.

The disease caused by these hairpin-like worms had long been wreaking havoc in our southern states. For ten years after Stiles identified his uncinaria, however, his was a voice crying in the wilderness. The "lazy germ," which was alleged to be causing the anæmia and jaundice among so many persons in the south was looked upon as a fad and a myth. The only place where anything was done about it was in Porto Rico.

For many years before the American occupation of this island, its people had been constantly subject to a fatal form of anæmia. In 1899 an alert army surgeon, Captain Bailey K. Ashford, became unduly inquisitive about this disease and by means of some capable detective work, found that hookworm was its cause. In 1902 he came on to Washington, studied the literature, consulted with Stiles, and then returned to the island with Dr. Walter W. King of the United States Public Health Service. Together they made a scientific investigation of the whole problem, induced the Porto Rican legislature to appropriate a few dollars, and then proceeded to extirpate the hookworm and the disease. Stiles got some of his specimens from Ashford and recognized that they were a distinct species.

Hookworms were known long before Stiles delved into their characteristics. The European cousin of the American necator was recognized in 1838 by an Italian physician, who bestowed upon it a euphonious name which eventually was converted into *Ancylostoma*

duodenale. The modern name of hookworm is an apt one, for these little worms, which are about half an inch long, actually are possessed of four hook-like teeth protruding from the rounded mouths. With these teeth they hook themselves on to the intestinal tract of their human hosts, where they feed on blood and thus cause anæmia.

The discovery of the manner in which the hookworm reaches the intestines is one of the most romantic episodes in the story of health. Like a number of other revelations in medical science, it was an accident. Prior to 1898 there were many conflicting ideas as to the mode of entry of hookworms into the human body, some scientists declaring they were swallowed, while others thought they were carried by animals, which transferred them in some way to man. In the year mentioned a professor in the medical school at Cairo, named Arthur Looss, was experimenting with hookworms when he accidentally spilled a culture of the larvæ on his hand. Soon after he noticed a dermatitis, or inflammation of the skin, and still later found the eggs of the hookworm in his feces. In succeeding years he proved that hookworms in the larval state enter the human body through the skin, especially through the feet. This knowledge made possible the effective sanitary campaigns which have prevented the spread of the disease in the United States.

The course of the hookworm from the outside world into the intestinal tract of man is a most interesting one. After the small larvæ of the worms have penetrated the skin they get into the blood stream, and by it are carried to the right side of the heart. From here they pass into the lungs, proceeding to the pulmonary

capillaries. As these are too small for them, the larvæ penetrate the tissues and go into the bronchial tubes, from which there is an easy passage through the trachea into the mouth. They are then swallowed and take up their residence in the small intestines. Here the larvæ molt and grow, fastening themselves by means of the hooks to the mucous membranes. From six to eight weeks after the larvæ have entered the body, the adult worm is laying eggs which are discharged in the feces of their host. The eggs hatch to larvæ in the soil and the cycle is ready to begin again on the next victim.

This cycle continued to go on for several years after Dr. Stiles made known its cause. Then one day about 1906 Stiles cornered Walter H. Page in a Pullman car on a trip south, and pumped the future ambassador full of ideas about that obsession of his. At first Page, like everybody else, was inclined to laugh at the crazy notions of the enthusiastic zoologist, but, in the words of Page's biography* where this incident is related, he soon discovered that Stiles was no fool. The cause of hookworm prevention then and there gained a notable convert, who, with the zeal of all converts, proceeded to proselyte others, paying particular attention to Dr. Wallace Buttrick, secretary of the General Education Board, which was financed by the Rockefeller millions. Buttrick in turn became enthusiastic and one day when he was doing a little Pullman journeying in company with Dr. Simon Flexner of the Rockefeller Institute and Dr. Frederick T. Gates, one of the oil magnate's close advisers, the conversation was deftly turned to Stiles and his work. Dr. Flexner had a high opinion of this zoologist, though he did not then know very much

*Hendrick, B. J.: "Life and Letters of Walter H. Page," Vol. I, page 99.

about the necator. At any rate, the end result of this casual talk was a contribution of a million dollars from Mr. Rockefeller for the purpose of exterminating the hookworm.

The Rockefeller Sanitary Commission was established in 1909. Half a dozen years later, activities against hookworm were being undertaken in ten states and fifteen foreign countries. The lethargy of the south with respect to this evil had been dispelled and all was energy and enthusiasm, so much so, in fact, that Stiles no longer evoked a grin with his ideas. One southern university even conferred an honorary "M.D." on this doctor of philosophy. The broadening influence of the Commission was recognized in 1913 by changing the name to International Health Board. Not only was hookworm attacked, but yellow fever was also assailed.* By 1921 more than forty states and foreign countries were receiving the benefits of the multifarious health activities of this board, which was then ably directed by Dr. Wickliffe Rose. By that year nearly 4,000,000 people had been examined and about half of them had been found to be infected. Stiles was vindicated with a vengeance.

SEDGWICK AS MENTOR

Professor Sedgwick, who lived next door to John D. Rockefeller, Jr., at Seal Harbor, Maine, in the summertime, was invited to become a member of the International Health Board in 1919 and served until his death in 1921. Among his fellow members on this notable board were William H. Welch, Victor C. Vaughan, G. C. Whipple and E. O. Jordan, the last

*See page 189.

named, now professor of bacteriology at the University of Chicago, having been one of his early associates in Massachusetts. Though a neighbor of the younger Rockefeller in the land of the pine, Sedgwick was far from a wealthy man. His indifference to the material benefits of a mammon-frenzied world was notorious, for, like the true scientist, he received ample recompense from his service to his fellow men.

Public service always claimed much of Sedgwick's time. From 1914 to his death he was a member of the Public Health Council of the State of Massachusetts and he was a member of many boards and committees. Perhaps the most important position he held, next to his chair at the M. I. T., was that of curator of the Lowell Institute. At the lectures of this famous annual course he always appeared wearing a tall hat as his badge of office, but he wore it as a gentleman and not as an eccentric. Because of his eloquence and gift of making a brilliant speech Sedgwick was always being called upon for an oration. I remember one occasion when, as a freshman at the Massachusetts Institute of Technology, I listened enraptured to him as he discoursed for an hour or more at a convocation on William Barton Rogers, the founder of the Institute. He was fluent and interesting, and every person in his audience could have listened to him all day.

The eloquence of Sedgwick and his charming personality did much for America on one occasion. He had gone to England in 1920 as an exchange professor at Leeds and Cambridge and after his most successful courses there had travelled to Brussels to attend an international health congress. There he represented the United States Public Health Service, the American

Public Health Association, Harvard, and M. I. T., and in this capacity had been called an "ambassador of health" by some of the Boston newspapers. After many bedecked and bedecorated diplomats from many lands had bored a distinguished audience with monotonous addresses, Sedgwick was called upon. From the moment he began the audience sat enthralled and when he finished his ten minutes of real oratory, it rose up en masse and cheered. Scores of people, including the American ambassador, went forward and congratulated him. "It was the climax of the convention," Whipple has written.

Those of us who had the inestimable privilege of being students under William T. Sedgwick are convinced that the greatest of his many contributions to progress was as a teacher. He was more than a mere preceptor, he was friend and guide to every one of us, no matter how humble. I never saw him impatient or discourteous, though there were, no doubt, inducements enough. He had no system of teaching and wandered from his subject as the fancy struck him. Sometimes we wished he would stick to the protozoa, or the epidemiology of typhoid, or whatever it was he was supposed to be expatiating upon at the moment, and yet, no matter what he said, it was worth hearing. All of us now in our more mature days realize that we were being taught one of the most essential things in life, human engineering.

Probably there are few other professors who have sent forth as many brilliant and successful pupils as did Sedgwick. Since 1887 his men have exerted a potent influence on national vitality, and a list of them to-day is literally the who's who in public health. Among them

are practising physicians, health officials, sanitary engineers, industrial hygienists, bacteriologists, biologists, laboratory workers, and professors. It is surprising how many teachers of public health he taught. Due to his inspiration each is in some degree carrying on the torch which he lighted.

The department conducted by Professor Sedgwick at the Massachusetts Institute of Technology was known simply as Course VII in Biology until 1911 when its broadened scope called for the new title of Biology and Public Health. Up to that time there had been about 150 graduates, most of whom had remained in public health work as professional sanitarians. Sedgwick had been successful in turning out experts in public health from an engineering school, but he realized how closely the training was linked with medicine. Acting on the suggestion of Professor Whipple of Harvard University, he was instrumental in bringing about an alliance between the Harvard Medical School and the Massachusetts Institute of Technology, whereby a joint School for Health Officers was created in 1913. This was the first such school to be launched on an ambitious scale and it had a marked success from the start. With the possible exception of the present School of Hygiene and Public Health at Johns Hopkins, lavishly endowed by the Rockefeller Foundation, it was the only completely successful school of public health.

"Was" is unfortunately the necessary term to use in speaking of this famous Harvard-Technology cooperative effort, which was so ably directed by a board consisting of Professor Sedgwick as chairman, Professor Whipple as secretary, and Dr. Milton J. Ro-

senau, who had come to the Harvard Medical School after a distinguished career as chief of the Hygienic Laboratory. In 1922, after the school had trained nearly 200 students, it was disbanded because at that time the Rockefeller Foundation saw fit to donate some two million dollars to Harvard University to support a new school of public health. Sedgwick, with his customary altruism, did not protest this one-sided gift, but Professor Whipple always considered it to be the mistake which indeed it was.

CHAPIN THE SKEPTIC

A city health officer who has held his job for more than forty years is such a rarity that he deserves special mention for that fact alone. Sound tenure of office is, unfortunately, not the staunch characteristic of American public health that it ought to be, and many a competent health officer has been released or expelled because of the whim of politics. Dr. Charles V. Chapin was appointed superintendent of health of the City of Providence, Rhode Island, in 1884 and has held that office ever since. Although there are a few other long-distance health officers, such as Dr. George W. Goler of Rochester, New York, who was appointed in 1896, it is doubtful if Dr. Chapin's record has been equalled.

Dr. Chapin merits his niche in the Hall of Health, however, for many other reasons in addition to his long survival as a municipal officer. He was, for instance, the first to establish a city health department laboratory, a step taken in 1888 and followed by the state of Rhode Island in 1894. It is as a skeptic, though, that Chapin has made his greatest contribution to public health. Since the death of his close friend, Profes-

sor Sedgwick, in 1921, Chapin is conceded to be America's foremost sanitarian. In 1926 he honored the American Public Health Association by being elected to its presidency, an office held by Sedgwick in 1916, by Park in 1923, and by Winslow in 1925.

The skepticism of Dr. Chapin was made manifest in 1905 when, at one fell swoop, he abolished fumigation after communicable diseases, on the ground that such gaseous disinfection was not only useless, but a delusion and a waste. Fumigation had been a fetish of health officers from time immemorial and they were slow at first to follow such a radical step. Not until 1915, for example, did the great city of New York consent to do away with this spectacular but futile procedure. Concurrent cleanliness during the course of a disease is now the watchword and fumigation has joined the limbo of forgotten rituals.

In 1910 Dr. Chapin issued a book entitled "Sources and Modes of Infection," which seemed so radical that it jarred the susceptibilities of many a complacent sanitarian. Again, the skeptic had refused to accept the lot of unsupported dogma which had accumulated in sanitary science. His book knocked down many of the gods then, but it is a classic to-day and ranks with Sedgwick's famous "Principles of Sanitary Science and the Public Health," first brought out in 1902.

A survey of state health activities was undertaken by Dr. Chapin in 1913 at the request of American Medical Association. This was the first and only such investigation ever made in this country and Chapin adopted the unique procedure of giving a numerical score, on the basis of 1,000 points for perfection, to the various states. None attained the maximum allow-

able though Massachusetts, which was the best, received 745 points. There were some rather low marks given and many state health officers felt grieved, but the net result was a notable improvement in state health administration in following years. The skeptic proved the wisdom of his agnosticism in public health.

A medal for distinguished service in public health, known as the Sedgwick Memorial Medal, was awarded to Dr. Chapin in 1929, after he had been unanimously chosen for this honor by a committee of the American Public Health Association. The establishment of this medal in commemoration of Professor Sedgwick followed a meeting called in 1924 by Dr. Victor C. Vaughan, in which the writer had the honor to be one of the participants. The first award was made five years later to Dr. Chapin.

THE TORCH OF THE CHIEF

The golden age in public health was distinguished by a number of other events in addition to those already described. In 1894 medical inspection of schools was first inaugurated, Boston having the priority in this important movement. In 1905 the causative organism of syphilis was discovered by Schaudinn and Hoffman and in the same year Dr. Prince A. Morrow organized in the United States a Society for Sanitary and Moral Prophylaxis, which began a vigorous attack on the venereal disease problem. The development of the Wasserman reaction in 1907 and the discovery of salvarsan by Ehrlich in 1910 gave impetus to this campaign, which is now effectively conducted by the American Social Hygiene Association under the skilful direction of Dr. William F. Snow, who as state health

officer of California in 1911 was the first to require the venereal diseases to be reported.

School nursing was begun in 1902, but child health gained its real momentum in 1908 when New York City established the first municipal division of child hygiene under the direction of Dr. S. Josephine Baker. The first national child health congress was held in New Haven in 1909 and out of it came a society with a long and cumbersome name, the modern descendant of which is the American Child Health Association, of which Herbert Hoover is president and Dr. S. J. Crumbine the director. The mental hygiene movement also had its inception in 1909, and in the same year Nicolle discovered that typhus fever is spread only by the bite of an infected louse.

Yes, it was a glorious period and I, for one, am glad that I was born early enough in it to have been able to witness some of the excitement. Professor Sedgwick saw it through, but we miss his counsel and guidance to-day when, as Pasteur remarked, there is still so much to be done. William Thompson Sedgwick died suddenly of heart disease on January 25, 1921, at the age of 65. His death was a shock to everyone, but it was especially so to me, as I had visited him the day before and had been invited to lunch with him, not at an exclusive club, but at a rather humble cafeteria on Massachusetts Avenue across from the Institute. There, among mechanics, clerks, students, and professors whose names adorn the rosters of numerous learned societies, we talked of many things.

"Your pen production excites my envy and admiration," he remarked, though I am certain that he was referring to its quantity rather than its quality, "keep

right on, that is one way to get ahead. Some day perhaps you will have material enough for the complete story of public health." Well, here it is, and Sedgwick himself is one of its heroes.

X

THE NEW SCIENCE OF NUTRITION

EATING was inaugurated several eons ago as rather necessary to the survival of man. After indulging in this essential activity for innumerable ages, man eventually converted eating into something of a pastime. He even made an art of it. To-day eating seems to be emerging as a science.

When you consider that man has been a masticating animal for millions of years, you would think that he would have learned something definite about diet in the early epochs of this considerable space of time. The science of eating, however, is one of the most recent of any of the branches of knowledge. Nutrition has actually been put on a scientific basis only within the past two decades, an infinitesimal speck in the passage of time since man began to take sustenance.

These vitamins, for instance, which are so essential to the modern dietary, are all products of the twentieth century, mostly of the recent years. The first of them to be recognized was discovered well after the turn of the century, and the last of them was discerned only a few months before this chapter was written. By the time this book has been published for a few months others may have been added to the six vitamins now belonging to this elusive chemical category.

THE FOOD OF PRIMITIVE MAN

Our ancestors in the dawn of the race were not worried about vitamins. They ate whatever they could and

often were lucky to get anything at all. Primitive man probably derived his early nourishment from growing plants, leaves, berries, and then grains and seeds, and after a while, roots and tubers. He may also have discovered the advantages of shellfish and one day he found a dead animal, tasted its meat, and ever afterward was not merely vegetarian, but carnivorous. Insects and eggs had been parts of the diet of man from early times. He may even have been cannibalistic when necessity arose, which was not infrequent.

Having ascertained that meat was a good victual, early man soon became a hunter. When he killed an animal, if it did not kill him first, he used the flesh for food and the skin for clothing. He was nomadic, wandering far in quest of the grains, grasses, and plants which would sustain him, besides seeking the living prey which feared him and fought him. Man took what there was when he could, and gave nothing back to nature, except his own kind.

One of the first allies of humanity was fire. No one knows how the flame first came to man, though there are legends enough, from the Greek tale of Prometheus, who lighted a torch at the sun and gave it to man, to the delightful essay on roast pig by Charles Lamb. Lightning from the heavens igniting the trees of earth may have been the real gift of the gods to man. At any rate, fire gave flavor to food, and this was one of the first advances in human nutrition.

As instinct developed, primitive man learned that certain foods disagreed with him more or less violently. These became tabu, probably about the same time when the dawn man realized that his safety was enhanced by setting apart certain sick people. Diseases due to faulty

nutrition must have been regular concomitants of man's early existence, just as they have been in later ages. Starvation was, no doubt, a frequent calamity, just as famine has also been well known in historical times.*

After struggling with a harsh existence for a long, long period, man one day began to follow the herd. He already had the dog for a friend, but his greatest ally came in that sturdy mammal, the cow. When cattle became the servants instead of the enemies of man, civilization had a foundation. When man first got milk from a source outside of his own mother, he made the greatest forward step in human nutrition.

The pastoral peoples who subjugated the cow builded wiser than they knew, for milk is the most nearly perfect of the foods of man. As civilization developed, the cow was exalted and in old Babylonia and ancient Egypt she became a goddess. Among the Hebrews, milk was considered the most valuable of all foods in that land which was so aptly described in one of its prosperous periods as "flowing with milk and honey." Throughout the ages those races which have fed on dairy products have been the most healthful and have attained to the greatest span of life.†

From the days of the lake dwellers in Switzerland, grain has been another of the staple foods of man, together with dairy products. Along the Nile and the Tigris and Euphrates, whose rising river waters annually made fertile the fields surrounding them, golden grain was grown and developed from time immemorial. These peoples likewise had their fruits and vegetables and the wealthy classes apparently enjoyed a fairly

*See the descriptions of the great famines in Chapter I, page 8.

†See Crumbine, S. J., and Tobey, J. A.: "The Most Nearly Perfect Food." Williams & Wilkins, 1929.

varied diet. "The king's messengers had good bread, ox flesh, wine, sweet oil, fat, honey, figs, fish and vegetables every day," says an inscription of the nineteenth dynasty in Egypt.*

The old Testament tells the story of an interesting dietary experiment "in the third year of the reign of Jehoiakim, king of Judah," which was 607 B. C. The king commanded the master of his eunuchs to bring unto him certain children of Israel, in whom there was no blemish and who were well favored, having ability to stand in the palace of a king. "And the king appointed them a daily provision of the king's meat, and of the wine which he drank; so nourishing them three years, that at the end thereof they might stand before the king."

"But Daniel purposed in his heart that he would not defile himself with the portion of the king's meat, nor with the wine which he drank," and because he was loved by the prince of the eunuchs, that official was prevailed upon to give unto the children of Israel pulse to eat and water to drink. Pulse in biblical lore means plain food, consisting probably of leguminous plants such as peas and beans. "And at the end of ten days their countenances appeared fairer and fatter in flesh than all the children which did eat the portion of the king's meat." When these children were brought before the king he found them in all matters of wisdom and understanding "ten times better than all the magicians and astrologers that were in his realm." The story is told in the first chapter of Daniel.

The Bible contains much on food, and the hygienic rules of the ancient Hebrews were thoroughly sound,

*Quoted in "The Newer Knowledge of Nutrition," by E. V. McCollum and Nine Simmonds. Macmillan, 1929.

so completely so, in fact, that many of them are not only observed to-day, but are full of modern wisdom and sanity. That is more than can be said about some of the dietary practices of the later Christian peoples.

THE EARLY AMERICAN DIET

When the first colonists landed in America they found a race which knew something about the cultivation of the soil. It was fortunate for the colonists that the Indians understood the growing of grain and of some crops, because otherwise more of these hardy pioneers would have starved than the many who did perish of famine and disease.

Soon after the Pilgrims landed at Plymouth they came across several bushels of golden corn while exploring and promptly appropriated it for their own use. They needed it, for that first winter on the bleak New England shore was a rigorous test of vitality. Disease, much of it due to malnutrition, took its toll of these rugged pioneers, but with the spring came new hope. Squanto, the friendly Indian, instructed the white man in the sowing of this fair grain, showing them how to put a dead fish in the soil to fertilize the crop.

The American Indian was not only a hunter, as he had to be, but a farmer of parts, and a fisherman, too. If he had not been all of these he would have had the pleasure of going hungry in the precarious existence of his day. The Indian's food consisted of corn, pumpkins, and other vegetables which he grew, and of wild fruits, and wild vegetables, which he found, in addition to the game and fish which he killed or caught. He made maple sugar and he knew how to preserve meat by smoking and drying. Viands bought, or stolen,

from the Indians played an important rôle in preventing the extermination of the early colonists in America.

From the days of Imhotep and Hippocrates physicians and wise men had cogitated on the influence of diet on health. That most versatile of the philosophers and scientists in North America, the great Benjamin Franklin, was interested in this subject, and disgorged himself of a few observations and rules on eating. In his early life Franklin was a vegetarian, but when more wisdom came to him, he discarded this fad. Another early American experimenter was Benjamin Thompson, afterward Count Rumford, who worked out some food theories in America and later tested them on the ravenous troops of the Elector of Bavaria.

NUTRITION IN THE NEBULOUS STAGE

When the American Revolution burst into action in 1776, Captain Cook had just demonstrated how to prevent scurvy by feeding his sailors the proper viands.* Shortly after the Revolution the first investigations of a nutritional nature in the United States were begun by a young medical student at the University of Pennsylvania. As a graduate thesis in the year 1803, John R. Young presented a study based on some unique experiments on frogs, snakes, and on himself and a friend named Mitchell.

Young adopted the apparently simple method of inserting a small frog into the stomach of a large one. He took the precaution, however, of tying a thread to the leg of the internal frog and pulling it out at intervals to see what effect the digestive processes were having on the amphibious victim. Other experiments re-

*See the story on page 60.

vealed to him new and unknown facts on digestion. These brilliant studies were interrupted by the death of Dr. Young from that relentless enemy of the race, Tuberculosis.

The spark kindled by Young was soon fanned into the flame of a glowing torch by another American investigator. His research, like so much that has contributed to medical progress, was based on a piece of good luck. In 1822 a young French-Canadian woodsman living in the neighborhood of Fort Mackinac was accidently shot in the left side. The bullet came out through the chest, tearing an opening under the left breast.

This injury may not have been good luck for Alexis Saint Martin, but it was for science. The patient was brought to the fort, where a young army surgeon named William Beaumont proceeded to treat him. Though apparently the wound was fatal, Dr. Beaumont and nature pulled Saint Martin through, though it took ten months to do it. The healing of the chest left a fistula, a window into the stomach, as it were, as this opening allowed examination of the organ and also the insertion and withdrawal of food or other material.

With this human laboratory available, it occurred to Beaumont three years later that he might perform some experiments and make some observations of the gastric juices and other internal matters of interest. By that time Saint Martin, whom Beaumont had cared for in his own home, had become a lusty man, capable of acting again as a wood-chopper. The studies continued for ten years, without inconvenience to the ambulant subject, but with some discomfort to Beaumont, who had to recover his patient every now and then when the

latter decided to go absent without leave. Once he disappeared for four years and was finally discovered in Lower Canada with a wife and two children.

In 1832 Beaumont made an unusual contract with Saint Martin, binding him to serve for one year as the subject of any experiment Beaumont might wish to make. The woodsman's compensation was to be "good sustenance, suitable housing, wearing apparel, washing, and $150.00." In the following year Beaumont published his classic report. Thereafter Saint Martin, who was then only twenty-eight years old, refused to be a laboratory any longer and never would be again, though he lived to be eighty-three years of age and never plugged the hole in his chest. He survived Beaumont by twenty years and when he died his family buried him eight feet under ground, so that his body would not be molested.

Beaumont was the first to describe the movements of the stomach, and his work on the physiology of digestion is the first great authority on this topic. According to Sir William Osler, Beaumont's studies on the digestibility of different articles of diet in the stomach remains to-day one of the most important contributions ever made to practical dietetics.

THE CHEMICAL PERIOD

Nearly half a century was to elapse after Beaumont's time before any notable contributions were again made to nutritional science. These advances, when they did come, were chemical in their nature, owing much to the substructure laid by chemists of previous centuries. As early as 1614, for instance, a scientist named Sanctorius

From "Ars de Staticia Medicina"

SANTORIUS ON THE STEELYARD

had devised a scheme for weighing himself while he ate. From the days of Lavoisier, who is generally conceded to be the father of nutritional science, most of the notable achievements in this important field have emanated from chemists or biochemists and not from physicians.

Antoine Laurent Lavoisier, a French nobleman and member of the Academy, was the first to use the balance and the thermometer in the study of human food and its effects on vital processes. In 1780 he began researches in the field of thermo-chemistry, designed to show heat production and the energy requirements of animals. In order to confirm experiments reported by Priestley in England and Scheele in Sweden he literally put a guinea pig on ice. He hollowed out a space in a block of ice and with his pig inside measured the amount of ice melted within a certain time by this docile animal. He soon transferred this cold-blooded experiment to human beings and with his physicist friend, Laplace, constructed a human ice calorimeter, which is still preserved and is on exhibition in Paris.

So engrossed was Lavoisier in these interesting experiments that he was much disturbed when the amiable and intellectual *sans culottes* of the French Revolution honored him with an invitation to be guillotined. In his aristocratic manner he suggested politely that the execution be deferred for two weeks until a few more results were obtained, but this entirely reasonable request was not granted and the interesting ceremony took place according to schedule in 1794. When the ax fell at the behest of Marat and his intelligent cohorts, there abruptly ceased experiments which might have been more valuable than all the revolutions of the next

century. It takes only ten seconds to decapitate a Lavoisier, but rather long to produce another.

After Lavoisier, came a Teuton named Liebig, who concluded in 1842 that the heat created in the body following the consumption of food was due to a burning process on the constituents of the food. In the same year another scientist named Joule showed how to measure the mechanical equivalent of heat and invented the term "calorie," destined to become famous in dietetics. Technically, the calorie used in nutrition work, the so-called large calorie, is the amount of heat needed to raise the temperature of one kilogram of water (2.2 pounds) one degree centigrade. This is about the same as raising one pound of water four degrees Fahrenheit.

CALORIES SUPREME

Once the calorie was nicely established the chemists interested in nutrition proceeded to have their fling. Pettenkofer and Voit of Munich in Germany made most elaborate studies on energy from food. They used a machine called a respiration calorimeter, which measured the oxygen absorbed by a man or animal, the carbon dioxide and water given out, and the heat produced by the body. Their pupils carried on their work and in 1892 one of them, Rubner, showed that energy is neither created nor destroyed in the animal body.

By 1900 numerous chemical examinations of dietaries had been made. The high priest of this work in America was W. O. Atwater of the United States Department of Agriculture who had been another of Voit's pupils. In 1894 Congress had appropriated the munificent sum of $10,000 for an investigation of the nutritive value of human foods. The duty was turned

over to the Office of Experiment Stations in the Department of Agriculture, of which Dr. Atwater was director, and activities were begun at Middletown, Conn. Dr. Atwater was fortunate in having the assistance, among others, of Dr. C. F. Langworthy and the late Caroline L. Hunt.

The chemical constituents of foods, the fats and carbohydrates made up of carbon, hydrogen, and oxygen, and the proteins, containing nitrogen and sometimes sulphur in addition to these other elements, had been worked out carefully by various investigators. The nutritive value of food was, accordingly, thought to depend entirely on the calorie values derived from these chemical combinations. Thus, to eat properly all that was considered necessary a quarter of a century ago, and even later, was to get enough calories out of any kind of food that the digestion would endure.

The respiration calorimeter is still an adjunct of certain nutrition and physiological experiments, though the original machine devised by Atwater was improved upon, first by Rosa and later by F. G. Benedict of the Carnegie Nutrition Laboratory in Washington. This scientist has gone even further and invented a portable respiration apparatus to replace the bulky air-tight chamber, so that this smaller machine can be used for teaching and in hospitals.*

Atwater and his cohorts and colleagues added much to the knowledge of nutrition, even though he and all the chemists of his day missed one vastly important factor in the real science of eating. Calories reigned supreme, but in spite of them people were eating in-

*See "The Foundations of Nutrition," by Mary S. Rose, Ph.D. Macmillan, 1927.

accurately. Energy is important to carry the human machine along, but energy is not also sustenance. There was another factor to be reckoned with. Once again luck stepped in and pointed the way to discover this unknown quantity or quality which really determined whether food was or was not nutritious.

THE SEARCH FOR THE UNKNOWN

The first clue to the unknown came suddenly and unexpectedly to a Dutch scientist in Java. In 1890 Dr. C. Eijkman was eagerly studying dietary deficiencies in his laboratory at Batavia, but his results were going all awry. The chickens he was using died so fast of paralysis that he thought he would be compelled to cease his experiments. Then they were better, but after a while worse again, and these strange happenings seemed to occur on the fixed diet he was feeding his birds.

One day Eijkman discovered the reason for these peculiar fluctuations. Instead of buying all his own supplies, the physician gave money to his native boy to purchase cheap rice for the chickens. The boy, like many boys, preferred to retain the funds, but he had to get rice for his master's precious chickens and so he begged it from the hospital steward. You may wonder what difference this procedure made, so long as the chickens were fed regularly. It made a most remarkable difference.

When the boy received rice from the steward it was white polished rice. The steward went away for a few days, however, and then the boy had to go out and buy rice and he bought the cheapest he could get, brown

unpolished rice. The chickens died when they ate polished rice, but lived on the unpolished. Malnutrition and disease were prevented by some secret thing, some mysterious influence in the outside layer of that brown rice.

The chicken malady resembled a disease of human beings called beriberi. Eijkman pondered about it and then he chanced to come across some interesting statistics, data which indicated, for instance, that beriberi was prevalent in districts where polished rice formed the bulk of the native fare, but it was absent from those places where the people were too lazy or indifferent to shell their rice. For once, torpor had a reward.

Dr. Eijkman thereupon proceeded to feed this unrefined rice, usually considered unfit for human consumption, to beriberi patients, in spite of the raising of the eyebrows of most of the hospital doctors. The patients recovered, the eyebrows were lowered, and the vogue and price of unpolished rice were increased. Eijkman had stumbled on a big thing. He had found that there was an unknown substance in food which would cure a dietary disease.

Few people paid much attention to this discovery. The Japanese Navy heard about it, however, and since this government had been struggling with beriberi as a dietary disease since 1884 effective measures were promptly taken to eradicate it from this navy. The disease was extirpated and a few years later these subtle Orientals used their naval establishment to good advantage, better than if their men had been poorly fed, in the War with Russia. In the Philippines an army medical officer, Captain W. D. Chamberlain, eradicated

beriberi from the ranks of the Philippine Scouts by applying Eijkman's discovery.

Sixteen years were to elapse after the first beriberi work before attention was again focussed on the unknown factor in eating. Then it burst into view in several places. In 1906 Dr. F. Gowland Hopkins, an English biochemist, was carrying on extended studies on nutrition, using rats as subjects in order to find out how to feed humans. When he fed his animals crude victuals, they lived, though in a somewhat blasé manner, but when he purified the food, they gave up the struggle and died. Then he suddenly found out that the addition of a tiny amount of milk to the diet made all the difference in the world. Milk-fed rats regained and retained their vigor and cut capers all over their cages.

Hopkins apparently had never heard of his Dutch predecessor in Java, and he waited for half a dozen years before he told the world that there existed what he called "an accessory factor of the diet," something apart from the proteins, fats, carbohydrates and minerals. Science began to appreciate this unknown factor, though, as usual, there remained considerable skepticism. Several investigators had been feeding rats on apparently purified substances, and yet evidently getting growth. The explanation for this discrepancy now seems to lie in the fact that the purified foods were, like the drama in New York, not actually purified.

In 1929, after the lapse of twenty-three more years since Hopkins conducted his research, he and Eijkman were jointly awarded the Nobel Prize. This belated recognition was not entirely due to the contributions on the vitamins made by these scientists, but for their innumerable studies of value to human welfare.

McCOLLUM SHOWS THE WAY

Other biochemists were rampant when Hopkins was doing his work. In our own Wisconsin Professor S. M. Babcock, who in 1890 had devised the well-known "Babcock Test" for milk, planned an experiment whereby cattle were to be fed rations containing the same chemical constituents, but each derived from a single plant, such as wheat, corn, or oats. The work did not get under way until 1911 when it was entrusted to E. B. Hart and G. C. Humphrey, with the later assistance of H. Steenbock and E. V. McCollum, a group of names which mean much in the modern field of nutrition.

Not much happened to these heifer calves for some months. At the end of a year, however, the results began to be striking. The corn-fed group was sleek and exhibited all signs of contentment, but the wheat-fed calves were scrawny and disgruntled. Those which had partaken of oats occupied a mid-position, as did a group of control animals, who were fed a mixed diet. The young born to the corn-fed cattle were lusty and well developed, while those of the wheat-fed were either born dead or quickly succumbed. Such were the results, but none of the investigators knew the exact reason for them. The search for the unknown was to continue with renewed vigor.

Since 1907 McCollum had been studying the cause of the failure of animals to grow on mixtures of purified food-stuffs. He had been using the domestic rat for this purpose, because it does not require a great deal of food, and since it has a relatively short span of life, much can be learned in a brief time from groups of

these experimental animals. In 1909 T. B. Osborne and L. B. Mendel of Yale, two more biochemists, began to investigate proteins of various kinds, hoping to find out the merits of each. They did establish the fact that some proteins were more valuable than others, but many of their results did not jibe with those of McCollum and his coworkers, so that for a time there was confusion all around.

Over in Germany a Polish chemist named Casimir Funk was also in quest of the unknown. He was one of the few whose attention had been arrested by the work of Dr. Eijkman on beriberi and he determined to repeat those experiments. Furthermore, he decided to try to extract the vital substance from the shell of the rice and after some time he managed to obtain a few crystals of a chemical, which resembled those organic compounds known to chemists as "amines."

"This unknown factor is vital, it is an amine," said Funk in 1910, "let us, therefore, call it a vitamine." Thus did the accessory food factor originally get its name, though the cognomen was not generally adopted until after 1920, when J. C. Drummond, who discovered the third one of these factors, suggested that the final "e" be dropped. The vitamins were then ready for the dictionary, as well as the palate.

The vitamin theory was hovering over science in 1914, needing only a lucky or skillful shot to bring it down. McCollum and Dr. Cornelia Kennedy had found that Funk's anti-beriberi "vitamine" not only prevented this disease, but also promoted growth. McCollum and Miss Marguerite Davis uncovered the fact that butter fat contained something which was necessary to nourish a rat. Since this substance was soluble

in fats, they called it "fat-soluble A" and gave to Funk's vitamine the name "water-soluble B." Thus the alphabet came into play as a source of titles for these hitherto unknown factors.

One of the first practical applications of this new knowledge of nutrition came during the World War. When the Austrians swept across Roumania they adopted that charming method of warfare which consists of making life miserable for all non-combatants and innocent by-standers. With true Austrian delicacy, the troops of Franz Josef drove away or killed all of the dairy cattle, so that fresh milk was lacking for the babies. Canned milk was, of course, not available and the infants and young children of Queen Marie's attractive country had to obtain what sustenance they could from a cereal diet of bread and soup.

Such a fare was lacking in vitamin A and the consequence was that a serious eye disease known as xerophthalmia soon developed. The situation was saved, however, when a scientist with the American Red Cross, Professor H. Gideon Wells of Chicago, procured a quantity of cod liver oil. When this had been doled out to the sufferers and consumed by them for a while, the eye disease promptly disappeared. Vitamin A had come to the rescue on a large scale.

Night blindness, which in the past has been common on long voyages, is another form of this xerophthalmia due to deficiency in vitamin A. This night blindness occurred among the Austrian prisoners of war in Russia during the World War and has been observed in many parts of the world, such as in Labrador and Newfoundland, where the winter diet is restricted; among negro slaves in Brazil; and in many sections of

the Orient. It was noted among the Indians by Lewis and Clark on their western expedition in 1806. Until science demonstrated the function of the vitamin in curing this disease, it remained one of the numerous medical puzzles.

THE SACRED COD

Cod liver oil, like butter fat, milk, and egg yolk, was realized to be plentifully supplied with vitamin A. Up to 1922 this vitamin and only two others were known, but in that year there was a culmination of evidence which proved that cod liver oil contains not one vitamin, but two, and that the second one is a distinct entity, a vitamin with a personality all its own. To-day this is known as vitamin D, or the anti-rachitic factor.

Vitamin D is called anti-rachitic because of its power to cure and prevent rickets, a disease of young children in which the bones fail to develop properly. The name of this disease is derived from the old English word "ricken," meaning "to twist." Even to-day this condition, manifested by bow legs, curvatures, and similar symptoms, is widespread, but, thanks to the gradual development of knowledge, usually occurs in a much milder form.

Experiments made on rats by McCollum and Simmonds in 1917 convinced them that rickets was due to something lacking in the diet, though they could not then tell what. Two years later, a British investigator, Dr. E. Mellanby, used puppies for feeding studies and concluded after some exhaustive work that rickets was caused by the lack of fats containing vitamin A. When cod liver oil had been substituted by Mellanby for other fats in the diet, rickets was prevented, but when Mc-

Collum repeated these experiments with butter fat, which is an excellent source of vitamin A, there was little diminution of the rickets. Here was a clue which seemed to indicate a new unknown, potent against rickets.

Further confirmation of this view came in 1921 when Hopkins showed that vitamin A could be removed from cod liver oil by heating it and passing oxygen through it. Even with the vitamin A gone, cod liver oil would cure rickets, a fact reported by McCollum, Steenbock, and Drummond all about the same time, but each working independently. Professor Henry C. Sherman and Dr. A. M. Pappenheimer had also thrown some light on this whole problem by showing the rôle of calcium and phosphorus in the diet. Thus was the fourth of the vitamins captured. The third, vitamin C, which prevents scurvy, had, as previously stated, been found in 1920.

The fifth of them was added to the growing list a year or two later when a California physician, Dr. Herbert M. Evans, announced that female rats need a special substance in the diet in order that they may reproduce normally. This doctor and his colleagues had already shown that vitamin A is necessary if reproductive powers are to be promoted, and so his "x vitamin" was received with interest. Further work has corroborated the existence of this unknown, which has come to be designated as vitamin E. It seems, however, that it is of more practical value in the provender cf the rat than in the diet of man.

As if five vitamins were not enough to satiate the inquisitorial actions of the chemists and biochemists, a sixth has recently been discovered. Vitamin F is not a

new one, however, but none other than our old friend, vitamin B, which evidently has been sailing under false colors and is really twins. It has also been dubbed B 1. The second half of this combination has been called vitamin G, or B 2, and the names were in a state of confusion in the latter part of 1929. Instead of actually calling this sixth unknown vitamin G, the alphabet was at first skipped a little and the new vitamin had also been yclept "P-P." This was because it is pellagra-preventing.

GOLDBERGER AND THE FIGHT AGAINST PELLAGRA

The quest for the pellagra averting substance has been going on continually for twenty years, its chief hunter having been Dr. Joseph Goldberger, late surgeon in the United States Public Health Service. Notable as have been the many contributions to science made by the personnel of this government bureau, it is doubtful if there has been any other recent example by them of sustained and eventually successful research, which can equal the work on this particular disease.

Pellagra is and has been excessively prevalent in the United States in the area south of the Potomac and Ohio rivers. Though seldom fatal when properly treated, the disease was as late as 1927 one of the foremost causes of death in certain of the southern states. At first it was thought that pellagra was communicable like smallpox, or that it was insect-borne, like malaria, later that it was organic, like cancer, but now, thanks to the patient and consistent work of Dr. Goldberger, it is known to be due to an unbalanced diet. Thus, it is especially prevalent among the poor, who cannot afford to have a varied fare. When times have been hard,

as they were in 1915, in 1917, and again in 1921 the disease has increased, but fallen off when prosperity returned. In 1927 there were more cases than ever, due to conditions following the Mississippi floods, but in 1928 and 1929 there were fewer.

A prison was one of the early laboratories where Dr. Goldberger conducted his experiments. His subjects were not rats, but human animals. A pardon was offered in 1915 to any of the healthy white men in the Georgia State Prison who would submit to the tests, and twelve men whose motives were possibly inspired more by the desire for freedom than the wish to contribute to science came forward. A carefully selected diet, consisting mostly of degerminated cereals, was fed to these convicts with the result that six of them showed signs of pellagra within six months.

Attempts to transmit the disease by inoculation with blood or by the secretions of the patients were not successful. As in the famous yellow fever experiments, none of these heroic human laboratory animals contracted the disease by such means. This important experiment indicated that pellagra was a dietary deficiency disease and further research corroborated the fact. To-day it is fairly well known just what foods cause pellagra and those which will prevent it, so that another scourge has yielded to the efforts of man. The best preventive of pellagra seems to be that former favorite of the brewers, yeast, which is especially potent for this purpose when in powdered form. Another staunch old standby, milk, is stated by Goldberger to be one of the most valuable single foods for the prevention and cure of the disease, and lean meat is another successful remedy.

Goldberger will no doubt some day get his monument as the conqueror of pellagra and step into the Hall of Fame with Walter Reed, Trudeau, Sedgwick, Stiles, and others who have vanquished specific diseases which afflict mankind. Except in the South, where a grateful populace looks upon Goldberger as a savior, few people had probably ever heard of him until they read of his death on January 17, 1929. This does not matter particularly because service to humanity is its own true reward and needs no blare of trumpets to enhance it.

Dr. Joseph Goldberger was born in Austria-Hungary on July 16, 1874, of Jewish parentage, and was brought to America when he was seven years old. He got his "M.D." at New York University in 1895 and entered the United States Public Health Service in 1899. During his career he contracted typhus fever, yellow fever, and dengue fever, all in line of duty. When he died his body was cremated and the ashes flung to the winds above the Potomac River. He was a gentleman and a scholar, with whom it was pleasure to discuss scientific and mundane matters, as I had the honor of doing on many occasions when we both lived in Washington, D. C.

The work of Goldberger has recently been confirmed by Chick and Roscoe of the Lister Institute and by others. The theoretical part has been done, but there remains the important necessity of its practical application. As usual, we know more than we use, but with the knowledge made available by the genius of Goldberger, pellagra can be relegated to the limbo of discarded diseases, along with yellow fever and the hookworm.

THE MODERN VITAMIN KNOWLEDGE

The most recent stunts performed on vitamins by the chemists have been those which separate them in concentrated form. Though Funk's crystalline substance was never obtained the second time after he performed the feat in 1911, the others have yielded to science. There is now evidence to show that the original vitamin B is not merely twins, but even triplets. Work done by Professor Walter H. Eddy and his associates has led him to inquire whether vitamin B is a substance or a system. Vitamin C has also been shown to possess a protective companion as yet of a somewhat unrecognized nature. Progress in refining the chemical processes concerned with vitaminology will undoubtedly be spectacular in the future.

With all this remarkable information available, the mere layman who is neither chemist nor physician may now get a fairly well-balanced diet, one which will promote health and happiness. The rules for right eating are comparatively simple, in spite of the erudite reports on nutrition which the scientists liberate every now and then.

The arrival of the vitamins does not mean that proteins, fats, carbohydrates, and minerals have been displaced as important factors in the diet, nor that calories no longer have any use. The vitamins are merely supplementary, though essential. The older favorites still have their rôle to play, and man, to eat wisely and well, needs protein to build tissue, fat and carbohydrate to supply energy, and minerals or ash to aid in bone and teeth formation and in other bodily processes. Energy from the fuel foods is still measured in calories, but

calorie-yielding foods must also be vitamin-containing. Thus, oleomargarine produces calories, but is generally deficient in vitamins. Butter, on the other hand, not only has calorie value, but is also rich in vitamin A. The sensible person would naturally use butter.

Vitamin A is usually associated with fats, particularly milk, cream, cheese, butter, egg yolk, and cod liver oil. It is stored in the lungs and liver, which is one reason why liver is such an excellent food. This vitamin is also found in leafy green vegetables, such as spinach, cabbage when young, and green peas, also in their youth, for the older these vegetables become, the less vitamin A they seem to retain. This vitamin not only promotes growth, but when stored in the human body adds to the resistance against disease, so that the more one gets of it, the better off is his physical welfare.

Vitamin B, which is really made up of the two associated elements, one preventing pellagra, the other warding off beriberi, among other things, occurs in milk, green vegetables, and fruits. The whole grain cereals are rich in it, but only so long as they are vulgar, coarse, and unrefined. With polish comes sterility, so far as the vitamin potency is concerned. Dried peas and beans have vitamin B, while spinach, a fine all-around food, is well supplied with it. Yeast has previously been mentioned as a most excellent source. This (or these) vitamin(s) promotes health generally, stimulates appetite, and aids digestion, besides being good for the nerves.

Vitamin C is the antiscorbutic, that is, prevents and cures scurvy. Its best source is the citrus fruits, such as oranges, lemons, grapefruits, and pineapples, and that well-considered and respected fruit, the tomato, which

is valuable raw, cooked, or canned. Leafy vegetables, such as raw cabbage, lettuce, and spinach are rich in vitamin C, which not only is the antidote to scurvy, but aids in bone development and helps keep infection away. There is some of it in milk.

Vitamin D aids in the prevention of rickets and plays other important rôles in human metabolism. Its chief source is cod liver oil, but it is also abundant in egg yolk. The remarkable thing about this vitamin is its stimulation in the body by the action of sunlight, the ultra violet rays of which form a chemical called ergosterol from the cholesterol in the skin. Vitamin D is, in fact, ergosterol, and this vitamin has been the first to be definitely catalogued as to chemical constitution.

Though sunlight has been recognized as beneficial to man since before the days of Zarathustra, it is only recently that science has explained the reason. In 1921 Dr. Alfred F. Hess in New York and P. G. Shipley, E. A. Park, G. F. Powers, and E. V. McCollum in Baltimore demonstrated that sunlight would cure rickets in rats. Dr. Hess has made many additional experiments and uncovered numerous interesting facts. In Wisconsin Dr. Harry Steenbock has also conducted notable research on this subject and has shown that foods may be irradiated so as to possess antirachitic properties. Dried milk seems so far to be the best of these activated foods. Ergosterol is also now irradiated and dispersed as a drug called viosterol for the treatment of rickets under the supervision of a physician.

Vitamin E is found in milk and butter, in seeds and green leaves. This vitamin has been found to be essential to reproduction in rats, though only small amounts of it are actually necessary. Because of its wide distri-

bution in many natural foods, most people will get enough of this vitamin and need not worry about sterility from any lack of this factor. If they secure an abundance of the health-giving vitamin A they will be amply protected in this respect.

In order to obtain a daily diet copiously supplied with all of the vitamins, the simple expedient should be adopted of taking care to include plenty of milk, fruit, and green vegetables as the usual fare. McCollum has called milk and the leafy vegetables "the protective foods" and he, as well as other leading scientists, such as H. C. Sherman, believe that the diet should contain not less than a quart of milk a day in some form, as well as a plentiful supply of salads. Such a diet will furnish not only these desirable vitamins, but also the minerals which are necessary.

NEW USES FOR LIVER

Of the minerals required by the body, calcium, phosphorus, and iron are, perhaps, the most important. Calcium and phosphorus help to build bones and teeth, assist in regulating various bodily processes, and aid in maintaining normal blood. Calcium may be obtained from milk and other dairy products, from wholegrain cereals, and from such leafy vegetables as spinach, lettuce, cabbage, kale, chard, beet greens, and also vegetables like carrots and turnips. Phosphorus occurs in milk, cheese, eggs, lean meat, fish, peas, navy beans, potatoes, and wholegrain cereals.

Good sources of iron are eggs, lean beef, dried fruits such as raisins, wholegrain cereals and the leafy green vegetables. Spinach is particularly rich in this mineral. The chief function of iron is to prevent anæ-

mia, as it is a necessary element in the blood, the iron-bearing protein, hemoglobin, acting as the carrier of oxygen to the various organs and tissues.

Pernicious anæmia has in the past been one of the organic diseases which has baffled medical science. In 1925 two scientists at the University of Rochester, Dr. G. H. Whipple and Dr. F. S. Robschiet-Robbins, reported that beef liver when fed to individuals suffering from anæmia after severe bleeding effected a rapid increase in hemoglobin and the red cells of the blood. Then two physicians at the Peter Bent Brigham Hospital in Boston, Dr. G. R. Minot and Dr. W. P. Murphy, found that patients with pernicious anæmia showed a remarkable improvement when fed a liver diet.

As a consequence of the success of this new treatment for pernicious anæmia and because of its general qualities, liver, which used to be fed to the cat, has become a popular article of the human diet to-day. The demand for it has increased tremendously and so has the price of this substance which a short time ago was often waste material. Thus do fashions in eating develop.

Iodine is one other mineral deserving of special mention. This element enters into nutrition because of its effect on the disease known as goiter, which is widespread in an extensive belt in the United States. Before iodine was found to prevent goiter in man, it had been discovered by a scientist appropriately named Marine that this mineral cured the disease in fish. Later, in 1917, this same expert, Dr. David Marine, with Dr. O. P. Kimball, demonstrated that the use of iodine would clear up goiter in the school children of Akron, Ohio. Other workers have applied this knowledge and

still other scientists, particularly Professor J. F. McClendon of Minnesota, have analyzed foods for their iodine content. By means of the practical use of this information goiter can be eradicated and thus another human affliction will pass from the scene. Let us speed its passing.

There is no modern excuse for the failure to secure a well-balanced diet. Such an achievement is economically and socially possible and adequate knowledge has been made available by science so that the individual may eat in an efficient and effective manner. The chemist has made possible the science of nutrition, a science which no faddist can change.

XI

THE ART OF LIVING SANELY

INSANITY is undoubtedly as old as the race, but mental hygiene, like so many other significant phases of public health, is new. As a social movement, endeavors to improve mental health are no older than the modern knowledge of nutrition, for the hygiene of the mind, now recognized to be as important as physical health or environmental sanitation, has been nurtured entirely within the last twenty years.

The art of living sanely is, moreover, necessary not only to the comfort, beatitude, and progress of the individual, but it is essential to the stability of civilization. Fortunate is it, therefore, that the present mental hygiene campaign was auspiciously conceived and that it is now a well-established and integral part of the modern health movement. Its development contributes much of the picaresque in the story of health.

When in 1907 a former "madman" who had regained his sanity was seeking to create a national society for the amelioration of the pernicious conditions then harassing the mentally disordered, a prominent psychiatrist suggested that this crusader call his group a "mental hygiene" committee. This was not the first use of this term, for it had appeared as early as 1843 in the title of a book by one William Sweetser, called "Mental Hygiene: or an Examination of the Intellect and Passions." Again in 1863 and in 1873 the words were employed in the names of books. Now the term is a can-

didate for the dictionary, for usage has made it of real etymological significance. Heritage has already set upon it a halo, and tradition has bedecked it with the wreaths of conquest. Let us see how and why; let us trace the evolution of mental hygiene and consider the great personalities involved in that development.

The story of mental hygiene, like so many of its precursors in this tale of public health, goes back far beyond the years of its recent growth, for a proper appreciation of some aspects of the movement requires that the narrative must deal with those unforgettable days of torment and cruelty when devils took possession of the souls of men, when other men, presumably not possessed of these demons, acted in ways far worse than those of the devils they purported to cast out. Much of the story is horrible, and some of it is revolting, but all of it is vivid. The contrast between the old days and the new in mental hygiene is like the exhilaration of emerging from the Black Hole of Calcutta into a June morning.

MEN POSSESSED OF DEVILS

These demons entered man early in his existence and took possession of his mind and spirit. Since these devils often seemed to come in the full of the moon, men and women who were moonstruck were regarded with awe and fear, sometimes even with reverence. Lunatics, moon-mad men, undoubtedly were more or less frequent in antiquity, though some writers have hazarded the opinion that there was much less insanity in ancient times than there is to-day. In Egypt, for instance, madness was apparently not recognized, though there is other evidence of it in olden times. Thus, the

Old Testament contains many allusions to mental disturbances among its leading characters.

Saul, king of Israel, who reigned more than 1,000 years before Christ, became possessed of an evil spirit, so that his servants sent for David, the shepherd, son of Jesse, to soothe the king with his harp. As it is told in the first book of Samuel (16th chapter), "And it came to pass, when the evil spirit from God was upon Saul, that David took a harp, and played with his hand: so Saul was refreshed, and was well, and the evil spirit departed from him." Some centuries later the only music allowed to the mad by their Christian curators was the clanking of the chains which bound them.

The same David fled one day for fear of Saul, mad again perhaps, and went to the king of Gath, of whom he was sore afraid. "And he changed his behavior before them, and feigned himself mad in their hands, and scrabbled on the doors of the gate, and let his spittle fall down upon his beard" (I Samuel 21). Where David pretended insanity, however, other kings of antiquity were really mad. Nebuchadnezzar, who ruled in the sixth century B. C., is one of the classic examples, and Cambyses, king of Persia about the same time, was an epileptic. Ajax (B. C. 671) was another of the afflicted.

The Greeks, with that enlightenment which characterized their consideration of hygiene and public health, looked upon manias and furies as diseases, whether due to demons or not, and prescribed treatments, diet, rest, drugs, and other medicaments for them. The story is told that Æsculapius received his first commission as a physician because of the madness of Nephele, second wife of Athamas, king of Thebes. Euripides and Aristophanes described or delineated madness in their dra-

mas. Orestes, in the "Electra" for example, was as crazy as King Lear. Hippocrates, the Father of Medicine (460 B. C.), wrote extensively on insanity, as he did on every other progressive medical and sanitary subject.

FROM DEMONS TO WITCHES

Just as the Greeks were somewhat enlightened as to the care of the individual insane, so the Romans made public provision for them in their jurisprudence. The famous Code of Justinian, completed in the sixth century, mentions insanity and admonishes the judges to consult physicians about those so afflicted. The law did not, however, require jurists to take the doctor's advice and most courts have, unfortunately, followed the same procedure up to the present time. Some of the exalted emperors of imperial Rome, the notorious Nero, for instance, were undeniably mad.

The dark period of the Middle Ages was one of torment and torture for the insane. One writer has called the centuries from 600 to 1750 a period of engulfment for imbeciles. The more dangerous and irresponsible of them were shut up in monasteries, while the harmless of the ilk were left to shift for themselves as best they might. They could starve or not, it mattered nothing to those worthy Christians.

Every now and then waves of group madness swept over parts of the world. The dancing manias of the fifteenth century* and the mental aberrations of the people after the Black Death were manifestations of public insanity. The Inquisition, that delicate method of religious fervor, was steeped in idiocy and many of

*See page 18.

the famous inquisitors were obviously dangerous lunatics. This accursed institution remained in force for five centuries or more, for after its establishment in Italy in 1233, in Arragon in 1240, in Castile in 1481, and in the Netherlands in 1562, it was not finally stamped out until 1808.

The *autos da fé* were by no means confined to heretics, but many alleged witches were burned. Not until 1672 did a French king, Louis XIV, have courage enough to abolish trials for witches. The pleasant custom of executing witches came over to the New World in the *Mayflower,* for as the historian Charles A. Beard says, "The very decade that saw the founding of Jamestown also witnessed a new act of the English Parliament laying the penalty of death on persons guilty of witchcraft, sorcery, charm, enchantment, and such infernal arts."

During the brief space of four months in 1692, honorable citizens of Salem, Massachusetts, hanged nineteen so-called witches, condemned eight, and pardoned fifty, after they had confessed to their iniquities. 150 more were permitted to languish in prison, and some 200 were accused. It is a question whether the victims or the persecutors were the more insane, but it must be stated that some amends were made later. This adventure in demonology was admitted to have been a mistake, but not until after the damage had been done.

BEDLAM

Bad as had been the Middle Ages in the treatment of the insane, the hundred years after 1750 were, if anything, even worse. This century was a period of brutal suppression, general ill treatment, and extreme cruelty

for those who got into the clutches of the keepers of persons considered to be lunatics. Of the many vile places for the incarceration of the dangerous insane, the hospital called Bedlam was unquestionably the worst.

Bethlehem Hospital had been founded in London in 1247 and began to take in "lunatics" about 1400, after which time it was devoted exclusively to these "wild beasts." Up to 1820 this delightful institution was literally one of the sights of the city, for public exhibitions were held there regularly. A morbid public eagerly paid fees for the privilege of gazing on the mad inhabitants, some of whom were even put through their paces for the entertainment of the customers.

One incident is enough to illustrate the horrors of Old Bedlam. A patient named Norris, a powerful and violent man, took offense at some unusually exasperating act of his jailer and indulged in a tantrum. For this offense he was so chained that the jailer in an adjoining room could jerk the chain and haul Norris against the wall. This cute device was apparently too mild, so a more sinister punishment was devised. An iron collar was rivetted on Norris and an iron band bolted about his body. His arms were pinioned and chains were fastened to him and to a vertical rod in the wall. The effect of this lovely contrivance was such that Norris could stand, though not erect, and could not move one foot from the wall. He was able to lie in only one position, on his back. There he remained without change of scene, breathing vile air, cold, hungry, tortured or neglected by brutal keepers selected from the criminal classes. The wonder is that he survived, but he did, for twelve interminable years. Think of it, in 1815 Norris had

spent twelve years under such conditions approved by the authorities. The average normal person would probably become a raving maniac after twelve weeks of such thraldom.

What medical care was accorded to patients in those days consisted mostly in bleeding them copiously. This ceremony usually took place in May when the victims were already wasted after a hard winter. After bleeding them for a while, they were purged and given vomits. Another charming treatment was to put an insane person into a rapidly circulating swing. No wonder those who survived these various orgies invariably got worse. Who would not?

PINEL TO THE RESCUE

The French Revolution was at the height of its frenzy when one calm man appeared. In 1792, when the insane asylums were especially crowded, due to the superabundance of personal liberty of the times, Dr. Philippe Pinel was appointed director of Bicetre, the refuge for the incurable insane. He was then a man of about fifty, a competent physician, and a humane gentleman, even if he did live in an inhuman period.

No sooner did Pinel take over his living charnelhouse than he demanded that his charges be unchained. "No," thundered the Commune, so zealous for individual liberty. But Pinel importuned and after making such a vigorous nuisance of himself that the ferocious Couthon of the Commune came in person to the institution to inspect it, he was told to do what he liked, and take the consequences.

Pinel decided to strike the manacles at once from fifty of his patients, one-quarter of the lot. The first

man he approached had actually been in chains for forty years. He was considered violent, as he had killed a keeper at one time, but Pinel approached the poor wretch alone.

"Captain," he said, "I have come to release you. If you will promise to behave like a gentleman and offer no assault to others, I will have your chains taken off."

"I would promise," replied the madman, "but you mock me, you amuse yourself, you fear me."

"Strike off the chains," said Pinel.

As a precaution the maniac was placed in a strait jacket when freed. He fell to the ground unable at first to employ his limbs, atrophied from disuse, but finally he made his way with difficulty to the door and emerged from his dungeon for the first time in nearly half a century. His first look was at the sky. "How beautiful," he cried, and heeding no one, gazed in rapture about him. Never again was he violent and in due course became a valuable assistant at the asylum.

In a few days, Dr. Pinel had liberated half a hundred poor wretches from their chains. Peace and contentment succeeded fury and bedlam to a remarkable degree. In the course of a year some of these erstwhile madmen were discharged as cured, though, of course, many were never cured. Their sufferings were alleviated, however, and they were treated like human beings and not as worse than wild beasts. Pinel was the founder of a new epoch in what was later to be called mental hygiene.

TUKE THE QUAKER

This innovation of Pinel's did not make much of an impression outside of France, at least for a time. Four

From a painting by Robert Fleury

PINEL ORDERING THE CHAINS STRICKEN FROM THE INSANE

years after Pinel had first banished chains, William Tuke, a benevolent gentleman of York, who had never even heard of Pinel, founded a hospital for the insane called "The Retreat." He had been distressed by a visit to St. Luke's Hospital where he found mad patients lying in chains on thin beds of straw, and he had determined to do something for these unfortunates.

William Tuke was a Quaker. He was not a physician or a social worker, but a wealthy merchant. As a philanthropist, he established his house of refuge, which promptly was assailed by the scorn and ridicule with which sundry morons at large always attack progress. The "Retreat at York" ultimately became a model for many institutions for the mentally deranged, and in a few years eminent physicians had abandoned mechanical restraint of the insane as useless and, indeed, harmful. Tuke, the Quaker, had triumphed.

To-day the chains, manacles, iron muffs, and other instruments of torture which once confined the insane are to be found only in museums, but many years were to elapse before all of the tools of bondage had been so consigned. Besides Pinel and Tuke, another of the notable pioneers was Dr. John Connolly of Hanwell in England. In our own country the first asylum for the insane had been established at Williamsburg, Virginia, under the auspices of the commonwealth. The Quakers, inspired by the work of their eminent coreligionist in England, began collecting funds in 1813 for a hospital for the insane and opened the Friends' Asylum at Frankford, Pa., in 1817. So-called lunatics had been treated in some of the general institutions, such as the Philadelphia hospital, which Benjamin Franklin helped found in 1752, and at the New York (1791) and Balti-

more (1797) hospitals, but those at Williamsburg and Frankford were the first to be devoted entirely to the humane object of caring for and treating persons who were mentally afflicted.

As the middle of the nineteenth century approached and the ideas of Pinel and Tuke had become established, the stage was set for a real crusade in behalf of adequate provisions for the insane. Stages which have been set in the story of health have seldom awaited for long the appearance of an actor willing and able to assume the rôle of hero. On this occasion, a heroine made her entry, a sober actress with a strong will and a weak body. Dorothea L. Dix held the stage for the next half century, but if she realized that some one was calling her an actress she would undoubtedly now be turning restlessly in her grave.

A TERRIBLE GENTLE LADY REFORMER

Dorothea Lynde Dix was once characterized by an admiring coworker, none other, by the way, than a descendant of Mr. Tuke, as "that terrible reformer, but gentle lady." She was without doubt the lobbyist par excellence, for due to her zealous efforts no less than thirty-two hospitals for the insane were established. She successfully harried laws through twenty-one more or less stubborn legislatures and she wheedled the Federal Congress into passing one of her pet projects, a bill for ten million acres to be set aside for the nation's insane. Dorothea Dix was truly a remarkable woman, and modern mental hygiene owes much to this crusading spinster.

A thorough product of old New England, Dorothea Lynde Dix was born in Hampden, Maine, on April 4,

1802. Her grandfather, Elijah Dix, was a physician, noted for his energy and honesty and also for his domineering and aggressive traits. Her father, on the other hand, was apparently as unsuccessful as the grandfather was successful. He was unstable, shiftless, and eccentric, and his daughter, displaying some of that indomitable spirit which she had doubtless inherited from her stern ancestor, deserted the paternal roof, such as it was, when she had reached the age of twelve.

After this hiatus, Dorothea made her home with her grandmother in the Dix mansion in Boston. It was a rigid existence, in which an ordinary childhood was lacking and love had no place. At the age of fourteen, this future reformer had actually become a school teacher, but only for a temporary period. Five years later, in 1821, she took up teaching in earnest, with the Dix mansion as the school and day pupils as the objects of instruction. By 1824 a lung affection had developed in the young preceptor and teaching had to be abandoned. This pulmonary defect continued to harass Dorothea Dix throughout life, though she lived to a ripe old age. It was undoubtedly the same disease which has afflicted so many celebrated persons, tuberculosis.

In spite of the handicap of the weak lungs, Miss Dix became in 1827 the tutor to the children of the eminent Unitarian divine, William Ellery Channing. From him she learned to accentuate her inborn altruism and through his influence she became inculcated with a humanitarian spirit. After a trip with the family to the West Indies in 1830, she returned to Boston and reopened her school, which continued in successful operation for five years. Then her health yielded once more to the strain and she gave up teaching to seek surcease

in a journey to England. There she spent eighteen months with the family of William Rathone, a prominent Unitarian layman, and there for the first time in her life she found affection. Greatly improved in health and spirit she came home in 1837.

Dorothea Lynde Dix became a reformer in 1841, when she was thirty-nine years old. A young theological student consulted her about a teacher for the Sunday School in the house of correction in East Cambridge, Massachusetts. Although in feeble health, Miss Dix volunteered, in fact insisted upon taking this rather unpleasant task. She found a cold, cheerless, filthy, overcrowded jail, with the innocent, the guilty, and the insane herded together. Her first act was to browbeat the jailer into providing heat in the zero atmosphere and her second was to tell the world, or at least the Hub of the Universe, how extremely rotten were the conditions. In doing this last feat she enlisted the aid of Dr. S. G. Howe, who in turn secured the interest of the redoubtable Charles Sumner. Reform was pregnant.

East Cambridge was the start of a campaign throughout the staid commonwealth of Massachusetts. From the Berkshires to the Cape went Dorothea Dix, notebook in hand, and when she finished her exploration that great and honorable legislative body known as the General Court of Massachusetts was the recipient of a somewhat poignant memorial from her pen.

The descriptions in this document of the madhouses in Massachusetts and their multifold abuses were so impassioned that the honorable legislators received a most severe jolt. All the almshouse keepers screamed "slander" and all sedate and sober people considered the conditions incredible, but supporters like Channing,

Howe, and Horace Mann helped sway popular opinion in support of this new apostle of decency in dealing with mental disorders. Dr. Howe happened to be in the legislature and he was amply supplied with ammunition by Miss Dix. He applied the spark and the resulting explosion shot a bill through the astonished legislature by a huge majority. Two hundred additional beds were promptly provided for the insane wards of the state.

THE DAUNTLESS DOROTHEA DIX

From the conquest of Massachusetts, Dorothea Dix stepped over into Rhode Island. She spent the remainder of her life stepping from one state to another and when she finished nearly half a century after she began her crusading career, the remainder of the chains had been struck from the crazy, the rods had been laid aside, and cages, closets and cellars had ceased to harbor those unfortunates whose minds had been lost. It is doubtful if there ever has been another indomitable reformer like this Miss Dix. Though often half dead herself, she persevered and by sheer personality and force of will accomplished her purposes.

Congress was the recipient of attention from Miss Dix in 1848 when she asked this august body to set aside five million acres for the use of the nation's insane. No action having been taken at the session in that year, she raised her modest request to 12,225,000 acres, an area nearly three times the size of her native state of Massachusetts. There were, however, a thousand million acres of public lands then available, though being rapidly snapped up by greedy speculators and predatory interests. A few million for humane purposes

were, perhaps, none too much, but it took the indefatigable reformer some years to convince the members of Congress of the fact.

Miss Dix was installed in an office in an alcove in the Capitol Library and there she held a continuous reception and also a class in social legislation. In 1850 the bill passed the House of Representatives with a flourish, but was deferred in the Senate. At the next session the Senate made amends by passing the bill first, but this time it got no action in the House. Not until 1854 did both houses act favorably, and the measure went to President Franklin Pierce for signature. Instead of affixing his name, this now obscure statesman vetoed the bill and thus the labor of years was all undone. Miss Dix had suffered her first serious defeat.

During her tour of duty in the Capitol, the militant middle-aged reformer accomplished one notable feat. She induced Thomas Blagden to sell to the government for $25,000 his beautiful estate in Anacostia in the District of Columbia for a hospital for the insane of the Army and Navy. Mr. Blagden had resisted all proposals from government agents for this ideal site high above a tributary of the Potomac, and had declared that he would never part with it for less than $40,000, would not, in fact, sell it at all; but he yielded to the persuasive eloquence, if not to the charm, of Dorothea Dix, and delivered the estate for its humanitarian purpose.

After the deluded Mr. Pierce had vetoed her pet project, Miss Dix dashed off to England, the steamship company insisting upon conveying her as its guest. Although she went on a vacation, she apparently could not resist the temptation to pry into the condition of the insane all over the British Isles. What she found in

Scotland resulted in the appointment by Queen Victoria in 1855 of a royal commission. When Miss Dix got sick, the queen's physician treated her and, all in all, she made a very successful invasion.

Off to the continent she traipsed next, and after recuperating in Switzerland, proceeded to Rome. There, with the aid of Cardinal Antonelli, she had an audience with Pope Pius IX in 1856. After more travel she returned to the United States and spent the next five years in continuing her efforts for the relief of the insane. In 1861 when the Civil War broke out she promptly reported to the Surgeon-General in Washington and was immediately appointed Superintendent of Nurses. Of her service in this position probably the less said the better. She was sixty years old, shattered in health, and not actually trained as a nurse.

When the war was over a stand of colors was presented to her for her "inestimable services." The flags are now in the possession of Harvard University, not far from which, in Mount Auburn, Miss Dix is buried. For fifteen years after the close of the war this indomitable lady continued her asylum activities until at the age of eighty, in 1882, she retired to the refuge of the hospital at Trenton which she had been instrumental in founding. During her five years sojourn here, many eminent persons visited her, and John Greenleaf Whittier sent her poems which he wrote especially for her perusal. She died on July 17, 1887.

After the death of Miss Dix there was a hiatus in the movement for the mentally ill. Although some of the satellites of the great leader attempted to carry on the good work, progress was frustrated by a record of failures in many of the hospitals where immediate suc-

cesses had been rather extravagantly predicted. Due to the lack of results and the impatience of the public, or that part of it which was interested, the inevitable reaction soon set in. The pendulum began as usual, to oscillate.

The pendulum swung all the way. Before long progress had not only ceased but there was actual retrogression. The hospitals reverted to the old status of asylums, places merely for the custody of mental patients, with little, if any, thought to their care or the amelioration of their conditions. These institutions became inaccessible, clannish even, and their standards declined. The hospital buildings often were permitted to degenerate and the morale and efficiency of the personnel suffered a corresponding deterioration. Once more in the story of health the stage is set for the appearance of an actor able to play a difficult rôle and revive public interest in a waning drama.

About ten years before the death of Dorothea Dix there was born in Connecticut a man who was destined to be the saviour for mental hygiene. A quarter of a century was to elapse after the passing of Miss Dix before the achievements of this man began to be recorded. His entry into the field was preceded by a most exciting novitiate.

THE MIND THAT WAS LOST

At dawn on June 23, 1900, Clifford Whittingham Beers, recent graduate of Yale, stole to the window of his bedroom and looked out long and earnestly. He was oblivious to the glorious sunrise of a June morning, for only one thought lurked in the brilliant but

strangely deranged mind. Suicide. But the thought lacked the impulse for the deed.

Not so at noon of the same day. There was a thud, a cry. When the members of his horrified family reached the scene, they found Beers in agony on the ground, four floors below his window. Fortunately, he had failed at suicide, though he was severely injured. Fate had something else in store for this man, but first he must run the gauntlet of delusion and delirium. He must be misunderstood and maltreated, provoked and persecuted. No martyr of old ever had a worse, though perhaps in the end, more profitable, experience.

Beers spent the next three years in various institutions for the so-called insane. Each was called a "sanatorium," a word meaning place for the salubrious treatment of disease, but these sanatoria aggravated, rather than ameliorated, the conditions of their unfortunate inmates. The attendants were invariably coarse, uncouth, illiterate, and incompetent, and they did not hesitate to curse and abuse their charges. When the patients rebelled, they were subjected to the indignities of muffs, camisoles and other diabolical devices, and this in the twentieth century.

The man whose mind was lost went through this gamut of torture. Because he was classed as a raving maniac, Beers was placed in 1901 in a strait jacket for twenty-one consecutive nights and somewhat later was consigned to a padded cell. From a padded cell to the sponsorship of an international conference on mental hygiene is a long step, but twenty years after he was released from this durance, Beers was fêted by the scientists of Europe whither he had gone as the emissary of our National Committee for Mental Hygiene, in the

interests of an international convention, a convention which was held in Washington, D. C., in the spring of 1930.

THE MIND THAT WAS FOUND

On September 10, 1903, Clifford Whittingham Beers went forth from an institution as a free man and apparently as a normal and sane one. His recovery from his breakdown had been as rapid as his mental decline. The mind that had been lost was regained. He sallied forth from restraint into a job, in which he endeavored with laudable ambition to make good, and did.

One idea was dominant in the thoughts of Beers, in this mind that was found, and that was to inaugurate a practical project for the alleviation of the miserable conditions to which the mentally afflicted were then subjected. He determined to write a book which should set forth his own experiences and pave the way for public action. His excitement and elation soon caused a temporary sojourn in another institution, but after a quiet month there, he came out completely cured and this time for good. That was a quarter of a century ago and since that time great things have been accomplished in mental hygiene, more or less directly as a result of Beers' harrowing experiences during those hectic three years.

The first edition of Mr. Beers' notable biography, "A Mind That Found Itself,"* appeared in March, 1908. "It reads like fiction," wrote William James, "but it is not fiction; and this I state emphatically, knowing how prone the uninitiated are to doubt the truthfulness of descriptions of abnormal mental processes." Many

*Revised Edition, 1930. Doubleday, Doran.

editions followed and many readers have been thrilled with the story of a man who really came back.

Two months after this book came out there was organized at the home of the Reverend Anson Phelps Stokes, the Connecticut Society for Mental Hygiene, with Mr. Beers as its first executive. A year later a national committee was formed, with the support of many leading scientists and humanitarians, including such well-known persons as Dr. William James, Dr. William H. Welch, Dr. W. H. P. Faunce, Dr. Henry B. Favil, and His Eminence, Cardinal Gibbons. This committee, with Mr. Beers as secretary, was spiritually strong, but financially weak, though Beers put some $10,000, mostly borrowed, into its formation. Later, in 1911, Mr. Henry Phipps gave the committee $50,000 and other wealthy persons and foundations contributed to its support. The modern mental hygiene crusade was launched.

THE GREAT OPPORTUNITY

In 1850 the number of persons in public institutions for the care of the insane was 15,610. Half a century later the number had multiplied tenfold and in 1910 when the National Committee for Mental Hygiene was getting under way, there were 173,641 such patients. Between 1880 and 1920 the number of individuals in institutions for mental disease in this country increased six times as rapidly as did the population as a whole.

Does this mean that we are gradually going mad? Is the pace too fast, is the modern mechanical era too strenuous and does it impose too great a strain on the nerves of an overburdened populace? These questions have been answered in the affirmative by a few scien-

tists, but the consensus of opinion seems to be that the apparently alarming increase in the mental afflictions can be explained as due to more facilities for the care of mental diseases, rather than to a startling increment in the number of cases. In our impetuous civilization there is probably no higher mental disease rate than ever, but if all existing mental maladies were diagnosed and recognized, many times the 50,000 who are now admitted annually to institutions for the insane would be in these hospitals. To-day there are about 165 hospitals of this nature with more than 250,000 mental patients. In 1850 there were only about twenty-five such institutions, while in 1900 the number was about 120. The number of persons in mental hospitals now almost equals those in all other hospitals combined.

When the National Committee for Mental Hygiene was getting under way, statistics as to mental disease were lacking and so one of the first activities was to collect useful data. Surveys were made in eight states during the first three years and since that time conditions in more than two-thirds of the states have been examined. Even as late as 1924 almshouses and jails were discovered as the abiding places for mentally sick persons guilty of no crimes or misdemeanors. Even chains were in use until a few years ago.

An investigation in a county in New York having a population of about 100,000 revealed at least 1,700 individuals with mental deviations. A study of suicides in Massachusetts showed that 58 per cent were afflicted mentally, and a survey of inmates of penitentiaries in New York uncovered psycho-pathological conditions among two-thirds of them. Studies of school children made by Dr. Walter L. Treadway of the United States

Public Health Service have brought out the fact that between 9 and 12 out of every 1,000 are mentally defective, though the rate for the population as a whole is about 5 per 1,000. This means that there are at present about half a million feebleminded persons in the United States.

At this point some definitions are in order, for mental disease and mental defect are two different matters. A mental defect is usually due to congenital causes and is manifest in such persons as the idiot, who is helpless; the imbecile, whose mental development is equivalent to a normal child of eight years, and the moron, who has the mentality of a twelve-year-old. The mental diseases include various constitutional and acquired conditions, from the major psychoses such as dementia præcox to the minor disturbances, such as St. Vitus' dance and amnesia. Patients with dementia præcox are now twice as numerous in hospitals as are all the patients in the sanatoria for the tuberculous. The term "insane" is strictly speaking not a medical one and has a usage only in law.

It is no crime to be mentally ill, nor is it necessarily a disgrace. Mental disease is frequently curable and as many as forty per cent of the persons admitted to state hospitals are now discharged as recovered or definitely improved. The greater portion of these cases resided at the hospitals for less than a year. Some mental diseases yield rapidly to treatment, while others are more chronic and persistent.

DOCTOR SALMON

From these facts, it will be seen that the movement inspired by Mr. Beers had a golden opportunity for

achievement. The need for scientific as well as enthusiastic direction was recognized early, and in 1912 the Committee was fortunate in securing the services of Dr. Thomas W. Salmon as medical director. With Mr. Beers as secretary, money-raiser, and promoter, and Dr. Salmon as psychiatrist, the mental hygiene movement then literally leaped forward. In addition to the surveys of the incidence of mental disorders, much educational work was undertaken in order to create popular and professional appreciation of the significance of mental hygiene.

Dr. Salmon rose to his greatest heights during the World War. Before our entry into that conflict, he and two other leading members of the National Committee for Mental Hygiene, Dr. Pearce Bailey and Dr. Stewart Paton, worked out a scheme for organizing military neuro-psychiatric units. At the request of General Gorgas this trio went to the Texas border in 1917 and investigated the psychiatric problem in our troops there amidst the cactus, the dust, and the sultry atmosphere, all of which conditions I can testify from personal experience under similar military disadvantages at Gerstner Field in Louisiana, would make almost any one neurotic or worse.

The result of this border experience and a supplementary trip to Europe by Dr. Salmon was the formation of a Section of Neurology and Psychiatry in the office of the Surgeon-General of the Army. When we entered the war, a systematic weeding out process had been applied to the troops, so that most of the insane, mentally defective and psycho-neurotic persons, some 72,000 in all, were rejected, or at least eliminated before the troops embarked for France. As a consequence

there were only about 2,000 patients who had to be sent home for the so-called "shell-shock," scientifically known as war neurosis.

The effect of this action likewise kept down the amount of crime in the A. E. F. and reduced the number of suicides. Dr. Salmon himself served in France as a colonel and senior consultant in neuro-psychiatry to the A. E. F. He came back wearing the red-and-white ribbon of the Distinguished Service Medal and with a personal message of thanks from General Pershing.

During the customary confusion of reconstruction, Dr. Salmon directed activities in behalf of the mental upbuilding of war veterans, as well as pushing forward the general work of the National Committee. With the aid of Mr. Beers, local societies were organized, surveys made, the public educated, conventions held, and mental hygiene advanced generally. Dr. Salmon was succeeded in 1922, as medical director of the National Committee for Mental Hygiene by Dr. Frankwood E. Williams, who still held that honorable position in 1930.

Dr. Salmon was drowned on August 13, 1927. At the 18th annual meeting of the National Committee which I attended on November 10, 1927, in New York City, the Reverend Harry Emerson Fosdick stated the feelings of all of that notable gathering when during the course of a fervid address he said, "Thank God for Doctor Salmon."

CRIME AND MENTALITY

Every year 500,000 persons in the advanced civilization in the United States pass through our penal and correctional institutions. What is it that causes men and women to break laws and commit asocial acts?

Wickedness, whatever that means, is the cause mentioned by the moralists. The explanation lies, however, in the mental condition of the culprit and the criminal, for the crime is a result of human behavior and is usually due to emotional defects. Many studies have shown that most criminals suffer from definite mental disorders.

At the beginning of its career, the National Committee for Mental Hygiene determined to investigate more thoroughly the relationship between crime and mentality. In 1916 the prison authorities of New York invited a study of the prisoners at Sing Sing Prison and the Committee designated Dr. Bernard Glueck, a leading psychiatrist, to conduct this important research. Dr. Glueck examined some 600 prisoners admitted over a period of nine months. The results confirmed previous opinions that criminals are different mentally from other people who are sane, and, as Mr. Paul O. Komora has written, "they shed a revealing light on the fundamental nature of the crime problem and threw into bold relief the psychiatric character of many of the vital issues determining it."

Of the group of prisoners, 12 per cent were suffering from obvious mental disease, 28 per cent were found to have intelligence equal to that of a twelve-year-old child, and 31 per cent were constitutionally unstable or psychopathic so as to render them unable to adapt themselves to ordinary human society. Other investigations have yielded similar findings. Thus, Judge Harry Olson in Chicago has reported that out of 679 suspected cases in the Boys' Court of that city, 654, or about 84 per cent, were suffering from dementia præcox, which he asserts plays the greatest rôle among the criminal psychoses.

As in all matters of vast social import, the prevention of crime is far more significant than its cure. Such prevention begins in early childhood and the most practical place for the necessary activities is the schoolroom. Psychiatric examinations of pupils would go a long way toward weeding out and effecting the proper segregation of those who are probable future delinquents. It should be stated, however, that not all those with mental disorders are potential criminals, for only about 20 per cent of the feebleminded actually get into trouble.

More than 60 per cent of the inmates of our jails are under forty years of age and most of them give histories of repeated offenses beginning at an early age. The steps from truancy to delinquency and from delinquency to crime are easy ones for certain types of personalities, which may have been influenced by either heredity or environment, or both.

THE GUIDANCE OF CHILDHOOD

In order to inquire into the prevention of juvenile delinquency and to evolve measures for dealing with it in an effective manner, the National Committee for Mental Hygiene joined with the Commonwealth Fund in 1921 in a five-year programme of child guidance. At first it was planned to set up child guidance clinics in connection with juvenile courts, but soon it was realized that child guidance is not merely a court, but a community matter. The first of these clinics was organized in St. Louis and others soon followed in Dallas, Minneapolis, St. Paul, Los Angeles, Pasadena, Cleveland, Philadelphia, and Richmond. At the end of the five-year period in 1927, every one of these cities had assumed

the responsibility for continuing this work and had made the clinics permanent.

"Child" guidance is largely parental guidance and really belongs in the domain of adult psychiatry. These clinics actually dealt with about 4,000 children during the five-year period, but their influence was even more far-reaching. The demonstrations served as the training-ground for the much needed professional worker, the psychiatrist, the psychologist, and the psychiatric social worker. One of the greatest gaps in the field of mental hygiene at present is the lack of sufficient personnel to carry on the many activities and projects. The National Committee for Mental Hygiene has attempted to remedy this defect in part by the establishment of fellowships and scholarships.

The students at colleges would probably not be flattered if the statement were made that the university offers a fertile field for "child" guidance. As a matter of fact, mental hygiene in colleges is a most important matter and in 1927 fourteen institutions of higher learning had recognized the fact and had established mental health services. Mr. Beers' own alma mater began such a demonstration in 1926 and this work at Yale has already been highly beneficial to many an anxious and harassed student, who needed a little adjusting and orientation.

People are interested in mental hygiene nowadays, as indicated, among other ways, by the distribution annually of considerably more than 100,000 copies of the pamphlets of the National Committee for Mental Hygiene. Since 1917 the Committee has been publishing a quarterly magazine called *Mental Hygiene* and it has also distributed a monthly bulletin. The small be-

ginning of Mr. Beers has grown into an influential, if not prosperous, organization. In 1928 plans were formulated for a mental hygiene foundation which would provide the financing necessary for this valuable work. This was incorporated as the American Foundation for Mental Hygiene on May 24, 1928.

Mr. Beers had builded well, and in 1930, as secretary of the National Committee, he was continuing with his customary fervor the valuable efforts to which his life has been dedicated.

MODERN MENTAL HYGIENE

"As an organized social movement," Dr. Frankwood E. Williams has written, "mental hygiene endeavors to draw attention to and stimulate interest in the importance of mental health and the tremendous social waste in mental illness and the relationship between mental illness and poor mental health and certain troublesome social problems such as delinquency, dependency, domestic difficulties, and industrial and social unrest."

Mental hygiene has, of course, another aspect, the personal one. That is the application of this art to the maintenance of individual mental health, for the hygiene of the mind is exactly as significant as the hygiene of the body. Just as physical health is measured in terms of radiant salubrity, with accompanying happiness and efficiency, so too is mental health measured not merely in terms of the freedom from disease, but in the ability to achieve and retain satisfactory human relationships, and to maintain a proper behavioristic attitude.

With the personal side of mental health we are not

concerned in this book, for our object has been to delineate those great events which have contributed to the development of that essential social movement known as mental hygiene. The reader can find plenty of weighty tomes, and some less weighty, on the popular aspects of mental welfare. In selecting them he would do well to look for works whose authors are able to write "M.D." after their names. A "Ph.D." may do in some cases, but mental hygiene, individually considered, is a branch of medicine, though as a movement it takes in law, psychology, social work, education, and general public health, in addition to medicine and psychiatry.

The task of mental hygiene is all ahead of it. In these days of speed and stress, of conflict and intolerance, of noise and other manifold irritations, some calm and sane influence is absolutely essential. Mental peace and the cultivation of behavior poise are not to be secured from adherence to pseudo-religious movements based on fanaticism, or from cults and fads, but from an intelligent conception of the tenets of mental hygiene, scientifically considered.

The goal of mental hygiene is to remove the causes of domestic and community strife, to assuage mental intemperance, to ascertain what motivates human behavior, and then to take such steps as are necessary to avert asocial conduct. This is the task of mental hygiene and who can deny that it is worth while?

XII

LENGTHENING THE SPAN OF LIFE*

Is it possible to extend life? If it is possible, is it worth while? In this advanced and enlightened era in which reckless and dogmatic assertions are rampant, is it presumptuous to claim that you and I and the rest of us have hopeful prospects of living longer and possibly physically better lives than did our forebears?

These are questions to intrigue philosophers and pundits and those superior individuals known as biologists, but the answers to these queries are also of some faint interest to the remainder of us, even the laity, many of whom are reputed to be able to derive value and enjoyment out of salubrious existence and healthful longevity.

CAN LIFE BE PROLONGED?

The solution to the baffling problem of life prolongation has been sought for countless ages. The greatest charlatan of all time, Cagliostro, claimed in the eighteenth century to have discovered that elusive compound, the elixir of life, but the prince of quacks died, somewhat prematurely, without having revealed the secret. None of the explorers in the realm of eternal life, none of the necromancers or alchemists of old, none of the gazers at crystals or the readers of the stars, have been successful in their quest for the fountain of youth.

*Portions of this chapter appeared in *The American Mercury* for July, 1929; *The Technology Review* for November, 1929; and *The Scientific American* for April, 1930.

Modern science has done better. It has demonstrated that life can indeed be extended. It has shown that death, inevitable climax to life, can actually be postponed in many instances. It has almost realized the prophecy of the psalmist that the days of man on earth shall be three score years and ten, a prediction which never has been an actuality for any race as a whole.

Individuals, many of them, do live, of course, to the proverbial seventy years. Many live much longer, though only about one person in 25,000 in this country reaches the age of a hundred. But the average span of life in the United States has never been as high as three score and ten years and so far as is known, the scriptural ideal has never been attained in any civilization or in any nation at any time, considering the people as a whole.

The average duration of life in the United States is to-day about fifty-eight or fifty-nine years, or some sixteen years short of the proverbial ideal. In 1910 it was about fifty-two years; in 1880 it was from forty to forty-five years; and, it is estimated, that in 1790 it was only thirty-five. Thus, in fifty years in one country alone, some fifteen years have been added to the average length of life, or to the expectancy of life, as the statisticians call it. What results will the next fifty years see in life prolongation? Certainly an average of at least sixty-five years could be promised, and promised soon, if the public would grasp the opportunities for health protection which science now offers to the people. Several years ago the American Public Health Association in solemn convention assembled made bold to resolve officially that the maximum expectancy was far from having been achieved and that the next half century

would promise a span of healthy existence even beyond the proverbial three score and ten. Already that prophecy has been partially realized.

The remarkable increase in the average span during the past half century represents an increase in the proportion of persons who live longer. The extreme span has not appreciably altered, for a few individuals have probably lived to a great age in every civilization. An average life expectancy of fifty-eight years does not mean that most people will die at that age. Moreover, a person alive at fifty-eight may still expect to survive for another sixteen years, according to the so-called life tables, which have been constructed as the result of accumulated experience.

The peoples of the past did not live as long as we do now and seldom did they live as happily, despite sentimental allusions to the "good old days." At the very time when the psalmist was predicting a life span of seventy years, and in the period when Egypt was a province of Rome, the average duration of life was only thirty years, according to reliable estimates. It was, however, no more than that several thousand years later, for a life table of 1780 in England gave a figure of only thirty years.

LIFE TABLES

The first really authoritative life table was constructed by Edmund Halley, the famous English astronomer and mathematician, for whom the comet which he discovered in 1681 is named. In 1693 Halley made up a life table based on the statistics of Breslau in Silesia and in it he gave an average life span of 33.5 years for that German community. About the same

time, another Englishman, named William Pety, essayed to establish mortality rates, according to a M. Deparcieux, who in 1746 wrote an interesting book in French on the probabilities of the duration of human life. In this volume, issued "avec approbation et privilege du roi," Deparcieux discusses Halley's tables and also mentions similar work done by Simpson of London in 1742 and Kerseboom of Holland in 1743.

Although the duration of human life has always interested savants, not many of them managed more than a century ago to get together sufficient data to compile these important life tables. Governments were particularly remiss in this respect, though a knowledge of how long its citizens may be expected to live is a matter of much political significance. The first life table of national scope was prepared for Sweden in 1783 by a Dr. Price, but not until 1843 did the British Government issue such data. At that time Dr. William Farr, often called the father of vital statistics, prepared a table based on statistics of the year 1841 which revealed an average life span of about forty years (40.2 for males, 42.2 for females) in England.

Official English life tables have been published regularly since that time, the ninth edition having come out in 1921. In that year the expectation of life for males was 55.6 years and for females 59.6, as compared with 43.7 and 47.2, respectively, for the period 1881–1890 as given in Table No. 5. The United States Government did not get around to the issuance of a life table until 1901, when data for only ten states, mostly in New England and the east, were assembled. These original registration states showed a span of life of about fifty years at the turn of the century.

Many years before the federal government bestirred itself in the matter of vital statistics, such important data were being collected and compiled in Massachusetts, most progressive of the states in this respect, if not in some others. As early as 1789 a clergyman, Edward Wigglesworth, issued an interesting and instructive table entitled "A Table Shewing the Probability of the Duration, the Decrement, and the Expectation of Life, in the States of Massachusetts and New Hampshire, formed from Sixty-two Bills of Mortality in the Files of the American Academy of Arts and Sciences in the year 1789." The reverend gentleman computed an expectancy of life at birth of 28.15 years, but when he made corrections according to the enumeration of actual inhabitants, his figure was raised to 35.47 years.

By 1850 the duration of life in Massachusetts had increased somewhat, for a table made by Kennedy in that year revealed that the expectation of life for males was 38.3 and for females was 40.5. Another table, put together in 1855 by Mr. E. B. Elliott, a noted actuary, indicated a life expectation of 39.8 years in that state, as compared with 36.7 in Prussia in the same period. Mr. Elliott pointed out, however, that the mortality among these New Englanders exceeded that of the Europeans between the important ages of 16 and 37, the prime of life.

The various figures for Massachusetts are all that are available for comparative purposes in our country. The gradual increase in the average span of life in this fairly representative state may be displayed in the following table:

YEAR	EXPECTATION OF LIFE
1789	35.5
1850	39.4
1855	39.8
1890	43.5
1895	45.4
1901	47.8
1910	51.2
1920	55.3

THE LIFE SPAN AT HOME AND ABROAD

The average life spans in the United States during the twentieth century are as follows:

YEAR	EXPECTATION OF LIFE
1901	49.2
1910	51.5
1920	55.2
1926	57.8

These figures for 1901, 1910, and 1920 are for the original ten registration states only, including Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Indiana, Michigan, and the District of Columbia. For 1920 the average life span for the whole registration area was 56.3 years, or somewhat greater than in the original registration states. The figure for 1926 given above is for the whole area. The data is for whites only and the figures for colored are much less favorable.

The countries in which the span of life is longer than in the United States are New Zealand, Australia, Denmark, Sweden, Norway, and Holland. Rows of figures seldom make rabidly interesting reading, even on such

an engrossing subject as the change in the duration of life, and so a mass of available data will be condensed herewith into one simple table showing how the span of life has increased in a number of European nations.

	EXPECTATION OF LIFE			
COUNTRY	FROM	IN	TO	IN
Bavaria	39.5	1891–1900	43.8	1901–1910
Belgium	45.1	1881–1890	47.1	1891–1900
England and Wales	40.9	1838–1854	57.0	1920–1922
Finland	42.8	1881–1890	46.3	1911–1920
Denmark	43.7	1835–1844	61.1	1921–1925
France	39.6	1817–1831	50.5	1908–1913
Germany	37.0	1871–1880	49.0	1910–1911
Holland	37.3	1850–1859	56.1	1910–1920
India	25.1	1881–1891	23.0	1901–1911
Italy	35.3	1876–1887	47.4	1910–1912
Norway	48.7	1856–1865	57.2	1911–1920
Prussia	36.7	1867–1877	48.2	1906–1910
Saxony	39.8	1891–1900	44.8	1900–1911
Scotland	42.1	1861–1870	54.7	1921
Sweden	41.5	1816–1840	57.0	1911–1920
Switzerland	41.9	1876–1881	56.0	1920–1921
United States	49.2	1901	57.7	1926

The answer, then, to the question as to whether life can be prolonged would seem to be in the affirmative, basing the conclusion on the fact that it has been extended and still is being extended. An undeniable increment of twenty-five years in the average duration of life in the United States between 1800 and 1920 is good evidence that real progress has been made in life conservation. During the first quarter of the twentieth century life has been lengthening at the rate of about forty years per century.

HOW HAS LIFE INCREASED?

Positive as is this demonstration that the aggregate length of life has been extended, this data could by itself present a false impression and it is, therefore, desirable to break it down into component parts. Although some one once coyly remarked that there are liars, damned liars, and statisticians, this profane stricture on the credibility of figures is not to be taken too seriously. Figures do not prevaricate when they are accurately determined, properly used, and correctly analyzed and interpreted. There is no sophistry in this matter of the span of life, but it is worth while to consider *how* it has increased.

The curve of death starts high at birth and it is high again in the later years of life. If mortality is plotted on the vertical axis and age periods on the horizontal, you will find that this curve for our current data begins with a rate of nearly 100 per 1,000 population at birth, but drops rapidly to the third year when it straightens out somewhat for a while. Then it rises gradually after the tenth year of life until it is going up rather parabolically from the forty-fifth year on. Infant deaths are equalled in about the seventy-ninth year.

Shocking as seems this high infant death rate, it is less than half what it was at the beginning of the present century. At that time there were 170 deaths of babies under one year of age to every 1,000 births; now there are only sixty-four. So, too, there have been corresponding, though less marked, decreases in death rates throughout the early periods. Here, then, is one explanation for the increase in the average length of

life. If only eight per cent of our babies fail to reach their first year, instead of sixteen per cent as formerly, the whole average is obviously raised.

What about the other end of this curve? That is probably of more immediate significance to our readers, many of whom may have reached a fairly mature, perhaps even middle, age. If life is to be expanded in the most efficacious manner, it is apparent that it must be prolonged in the period past fifty.

Here, unfortunately, we strike a snag. Although there has been a gratifying increase up to this age, the increment at that time becomes almost negligible, and afterwards it does not exist. There are even those who claim we are going backwards. In a recent issue of *Science,* a professor of mathematics at Dartmouth College maintains that all of the great gains at the early ages are now being more than offset by the losses at the advanced ages. This writer even claims that the average length of life in this country is now actually decreasing.

Despite such a single pessimistic viewpoint, there is ample hope for the future. There is available extremely significant evidence that life prolongation in adult life is as feasible as in early life. To be sure, deaths from heart disease, somewhat more frequent in later life, are now the leaders in causing mortality in this country. Tuberculosis, long the captain of the men of death, and frequently the despoiler of young manhood, has dropped to fifth place. Ahead of it are heart disease, cancer, nephritis, and cerebral hemorrhage, in that order.

To the sanitarian belongs most of the credit for the present achievements in life prolongation, though bio-

logical, economic, sociological, and educational factors have also played a part. The future accomplishments in this game of life will still be founded to a considerable degree on the efforts of those who are dealing with the environment of man. Typhoid fever, for instance, now causes a mortality only one-fifth as great as a quarter of a century ago. What is left of this disease after its demolition by sanitary science is rural rather than urban. Here is a poignant example of environmental control.

FACTORS IN LONGEVITY

The traits of our ancestors have always been considered to play the most important rôle in producing longevity. If it has been customary for our forebears to live to ripe old ages, the chances are supposed to be favorable for us to emulate them. In other words, heredity has generally been looked upon as one of the chief influences in determining the length of a particular life.

This assumption is, of course, based on the hypothesis that the individual will overcome the hazards of his environment in early life, for while heredity may assist a person to recover from the ravages of a bacterial invasion, it may also fail to do so, as unfortunately, has frequently happened. The individual must, in fact, be able to cope with unfavorable environmental conditions throughout life. In many instances he may exert some personal control over his surroundings, so that his own health will be protected and promoted, but in many other cases, he must depend upon the organized efforts of society to safeguard the public health.

Among the important elements which may be classed

as environmental is nutrition. The human experience of a considerable period of time, for eating is a fairly ancient art, has indicated that the nature of our diets may definitely affect longevity. It is a well-recognized fact, for instance, that those races which have been nourished on foods containing a preponderance of dairy products have always been the most vigorous and long-lived, as well as the most important historically. The conquerors have been users of cows.

Now we have scientific evidence to support these age-long observations. In 1928 a report was made before the National Academy of Sciences in which it was stated that the influence of a single change in the food supply upon longevity seems to have been fully demonstrated. This significant report was rendered by Professor Henry C. Sherman of Columbia University, who is one of our leading authorities on nutrition, and who had been making notable contributions to the new science of dietetics for many years.

NUTRITION AND THE LENGTH OF LIFE

The experiments of Professor Sherman were carried out on a flock of those docile laboratory animals, white rats. About 400 of them were concerned in this particular investigation in which two groups of these animals of identical heredity were given two diets. One of these diets was adequate from the standpoint of nutrition, for Professor Sherman still possesses rat families which have thrived on this particular diet for more than twenty-one generations. This fare consists of a mixture of one-sixth dried whole milk, five-sixths ground whole wheat, a little salt, and plenty of dis-

tilled water. Not very thrilling from the standpoint of variety, but certainly a nourishing regimen.

The second diet was not only adequate, but distinctly better and this superiority was obtained merely by doubling the amount of dried whole milk, so that the ratio was one-third milk powder, two-thirds whole wheat powder, with salt and water as before. By this change an *adequate* diet was converted into an *optimal* one, and some rather phenomenal results were obtained with it. The average duration of life was almost exactly ten per cent greater in those subjects receiving the optimal diet than in those favored only with the adequate diet. These results were, furthermore, subjected to rigid statistical analysis and found to be truly significant and not accidental in the order of about 100 to 1, which is leeway enough to satisfy the most meticulous biometrician.

Results such as this with appropriate laboratory animals can be translated into human terms. While some men have been called rats, the converse is hardly true. The white rat does, however, exhibit the same nutritional characteristics as man and having a comparatively short, if hectic, career, this rodent is a valuable subject for dietary investigations. In terms of human experience, therefore, this notable investigation indicates that at least six years might be added to the span of human life by means of suitable attention to the securing of an *optimal* diet. Here, then, is the one possible solution to the problem of the extension of adult life and the cutting down of the curve of death in the advanced ages. The results of the experiment elicited the following comment in an editorial in the usually blasé *Journal* of the American Medical Association for

January 5, 1929, "The investigators also point out that this gain in longevity resulted from a single and simple dietary improvement, and that it is altogether probable that the better of the two diets here studied is susceptible of being still further improved. Hence it is entirely reasonable to hope that further investigation may show possibilities of even more gratifying improvements in longevity, through the application of the constantly growing knowledge of nutrition."

If you delve into history you will find that certain races have been more vigorous and long lived than others, a fact which cannot be explained on a purely biological basis. It has been food selection rather than natural selection which has caused this phenomenon. As has been pointed out by Professor E. V. McCollum of Johns Hopkins University, the pastoral peoples of the world who have had possession of many dairy animals and whose diet has consisted mainly of the products of these animals have, without exception, always displayed the finest physical development and the greatest tendency toward longevity.

In a remote part of the Himalayas is an isolated race with magnificent physique, the members of which seem to have found that elusive fountain of youth, for they retain until late in life the characteristics of youth. Since gland transplantations have not yet made their way into this secluded part of the world, the explanation for this unusual virility and fertility is primarily one of diet. As reported by Dr. Robert McCarrison of the British Medical Service, these people subsist on a frugal diet, consisting mostly of goat's milk and vegetables. Another British scientist in India, Dr. D. McCay, has found that the pastoral Indians of the few

good dairy regions of that country are always vastly superior to the more numerous natives who live only on cereal grains.

There is an Arabian proverb to the effect that he who has health has hope and he who has hope has everything. The Arabs are fortunate in that they have something besides hope which contributes to their health, and that something is milk. According to various writers, the fare of the pastoral Arab is mostly milk, supplemented with only a moderate amount of meat, cereals, and dates. The milk is that of goats, camels, and sheep, and because of the intense heat, is soured at once and eaten in the form of curds. Even Napoleon's surgeon-general, on the great commander's Egyptian campaign, described these lean, sinewy hawks of the desert as more perfect in physical structure than most Europeans.

Throughout wide areas in Asia milk is also the staple article of diet of many races who lead a precarious existence. The Mongols must live on milk or starve. They do not starve, but are wiry and vigorous, though a thin race. The Tartars at times live almost exclusively on mare's milk and thrive on it. Marco Polo on his peregrinations was much impressed by a milk wine which has been manufactured by the Tartars since the thirteenth century.

The dominant and aggressive peoples of the world have always been those whose nutrition has been of the best. It is related of David that he was carrying ten cheeses for the nourishment of his cohorts when he met and conquered the redoubtable Goliath. The conquerors have always been users of dairy products in abundance, and not of grasses and grains, nor of meats. The beef-

eaters, so-called, of England have also been drinkers of milk as well as of some more potent beverages. The Scandinavian countries, where the span of life is so much greater than ours, have always been noted as dairy countries, and the same is true of Holland, another country where the average life is longer.

FUTURE PROSPECTS

How far may we expect to go in this matter of life extension? Here is a field for some interesting speculation. Can we base our future prospects on past experience? Is there a definite limit to the average span of life? How long will we live in 1950, in 2000, etc.? The answer is partly conjecture, though there may be some scientific grounds for the estimates of future longevity.

In 1908 President Roosevelt appointed a National Conservation Commission to study the conservation of our natural resources, such as forests, oil, minerals, soil, and water. Since human life was rumored to be a fairly important natural resource and rather necessary to the enjoyment and economic utility of these inanimate resources, an investigation of its conservation was also made, the surveyor in this case being Professor Irving Fisher of Yale University.

In his *Report on National Vitality,* Professor Fisher analyzed existing conditions and then calmly prophesied that fifteen years could be added to the total prolongation of life, merely by applying the methods of prevention of disease understood at the time. This prognostication was looked upon by many persons as decidedly rash. Twenty years later, however, a considerable portion of this augury had come true. In 1927

Professor Fisher became even more reckless and proceeded to predict that in the year 2000 the average length of life will be 82 years.* Time will demonstrate the verity of this assertion.

Members of the statistical fraternity like to ruminate on the prospects of life extension. In 1915 B. H. Forsyth, in a contribution to the quarterly publication of the American Statistical Association for December of that year, estimated that thirteen years could be added to the span of life. In 1922 Louis I. Dublin, a well-known statistician, addressed the Harvey Society of New York on the possibility of extending human life and informed his hearers that ten years could be added to the duration of life merely by the application of existing public health knowledge. He prepared a hypothetical life table based on the United States table for 1910, but with the assumption, devolving upon scientific evidence, that death rates at various ages could be reduced from one-third to one-half.

The death rate in the United States was 19.8 per 1,000 population in 1880. It was 17.6 in 1900 and 15.0 in 1910. It had fallen to 13.1 in 1920 and still further to 11.8 in 1925. From all causes there were in 1925 a total of 1,219,019 deaths in the United States. If the rate of 1900 had still prevailed, there would have been nearly 600,000 more deaths in 1925 than actually occurred. You and I may be among those fortunate half million persons.

Whether we shall reach the goal set by such enthusiasts as Professor Fisher and Dr. Dublin may be problematical, but it does seem likely, even fairly certain, that the life span will increase. When it is possible to

*Fisher, I.: "Lengthening of Human Life in Retrospect and Prospect." *American Journal of Public Health*, January, 1927.

accomplish a thing, the goal is usually attained, though we know infinitely more about public health in this country than we use.

Is there such a thing as life eternal? Since 1912 Dr. Alexis Carrel of the Rockefeller Institute has kept alive his celebrated chicken's embryo heart by the simple expedient of maintaining it pure and free from infection. The unicellular forms of life are practically immortal, as has been shown by Professor L. L. Woodruff, a Yale scientist, whose pet protozoa, of the genus Paramecium, displayed no proclivity toward death during 8,500 generations, which may be computed as equal to 250,000 years of human life. Such studies may be interesting and suggestive, but at present they have no practical application to human life.

Even though the average length of life can be extended, its ultimate length will probably remain more or less fixed. The limit is about one hundred years, but now and then a person will live longer and on rare occasions some one will exceed the limit by a quarter of a century or more. There is on record one life span of one hundred and forty-six years in a Norwegian named Drakinberg, who was born in 1626 and who died in 1772. According to the statistician, Harald Westergaard, who investigated this case and considered it authentic, this young fellow married at the tender age of one hundred and eleven and as a widower of one hundred and thirty the gay old philanderer attempted to marry again, but without success.

SOME FAMOUS CENTENARIANS

Many individuals are said to have lived more than one hundred years, but most of the reputed centenarians

are found on rigid investigations not to be centenarians at all. The age of a very old person is one of the matters most susceptible to deviation from the truth, for memories are hazy in the extremely old, and friends, neighbors, and newspapers seem always ready to exaggerate such sensational affairs. A few years ago a Kentuckian named John Shell received considerable notoriety as being one hundred and thirty-one years of age, but a somewhat searching inquiry revealed him to be not more than one hundred, if he were even that.

In 1904 a Russian newspaper calmly reported the death at the advanced age of one hundred and eighty of a woman named Therese Abalva. Another Russian newspaper in 1926 was more modest, for it allotted only one hundred and thirty-eight years to Ivan Tretya, a peasant of Rostov.* A Hungarian farmer, Peter Zortay, exceeded them all, for he was supposed to have been one hundred and eighty-five when he died in 1724. The cautious reader regards these allegations with as much skepticism as interest.

One of the most famous of the very aged persons of history was Old Parr, who was said to have been born in England in 1483 and to have died there in 1635. He was working blissfully as a farm laborer at the tender age of one hundred and fifty-two when an interested nobleman whisked him off to London and put him in an exhibition. The fast life of the metropolis proved too much for him and he promptly succumbed. Thereupon, one John Taylor, known as the "Water Poet," got out a book called "The Olde, Olde, Very Olde Man," in which he extolled this long life in prose and verse, or what passed for verse. William Parr was said to have

*Nash, J. V.: "Some Famous Centenarians." *The Open Court,* November, 1927. Vol. XLI, No. 11.

married at one hundred and twenty and after the suitable interval to have become the father of a child. When he died in 1635, the celebrated William Harvey, discoverer of the circulation of the blood, performed an autopsy on him and found his general condition good, though the brain cells were somewhat worn.

Old Parr's unusual age was generally accepted until 1873 when Mr. W. J. Thoms, deputy librarian of the House of Lords, who was so unkind as to make a real investigation of the case, concluded that about fifty years had been improperly tacked on to the actual life of Parr. He was a real centenarian, but little more than that. Mr. Thoms also exposed two other notorious long-lifers. A certain Countess of Desmond was credited with one hundred and forty years, but the doubting librarian showed that the ages of two separate countesses of the same name had been added together. Instead of one person living to one hundred and forty years, two ladies had each lived about seventy. Thoms examined in all twenty-two cases of alleged great longevity and found that none of the records sustained the contentions of centenarianism.

A writer familiar with Mr. Thoms' iconoclasm on this subject, a Mr. John B. Bailey, wrote a book in 1888 which he called "Modern Methuselahs," and in it he cited a number of instances of well-known centenarians and nonogenarians. He began with St. Anthony, who was said to have lived to one hundred and five, but most of his other examples, such as the Emperor Cantacuzenus of the fourteenth century, Pletho, Cornaro, Titian, de Fontenelle, and Amory, were only ninety-nine or one hundred. The author, however, did list a dozen persons whom he believed to have been actually one

hundred years old or more. This writer waxed philosophical in his final chapter and, while admitting that these human century plants reached their great ages in spite of a diverse variety of habits, offered a recipe for longevity. His three essentials for "long-lasting" were: (1) good heredity, (2) good digestion, and (3) bodily and mental activity, and he quoted with approval these words of Sir Benjamin Brodie, "Men have been known to die, literally speaking, of disease induced by intellectual vacuity."

One of the best surveys of centenarians was made in 1899 by T. E. Young, former president of the British Institute of Actuaries. At that time he could find only twenty-two indisputable instances of such aged persons, but in a second edition of his book published in 1905, he added eight more. The longest authentic life he could discover was one of nearly one hundred and eleven years. Mr. Young discusses all the previous works on longevity, of which there had been a considerable number, such as the books of Flourens in 1855, of Pinney in 1856, and of Humphry in 1889, as well as that of Bailey alluded to above.

In a rather weighty tome on the prolongation of life, Professor Eli Metchnikoff, the famous bacteriologist, hazarded the opinion some twenty years ago, that human life ought to average at least one hundred and twenty years. In his book he describes various persons who were supposed to have attained great ages. Among them were Marie Priou, who died in 1838 at the alleged age of one hundred and fifty-eight after subsisting for most of her life on cheese and goat's milk; and there was also Nicole Marco, who lived to be one hundred and ten on a diet of bread and milk.

The Metchnikoff formula for long life was to drink soured milk containing the Bulgarican Bacillus, though he also recognized the value of hygiene and sanitation. To-day it is known that it is not the B. Bulgaricus, but the acidophilus bacillus in soured milk which exerts a favorable influence on the digestive tract and hence contributes to longevity. Metchnikoff's theories were based on observations on the vigor and longevity of various Balkan peoples who lived on such a fare. Bulgaria is claimed to have more than 3,000 centenarians even to-day, while other Balkan countries such as Rumania and Turkey are likewise so favored. A woman, Maria Ustav, who died in Carcalia in Rumania in 1927 was asserted to have been one hundred and thirty-five, while Milo Frantsitch of Yugoslavia, who also died in 1927, was reputed to be one hundred and twenty-six. Zaro Aga of Constantinople was living there in 1930 at the alleged age of one hundred and fifty-six. These people are undeniably old; you can believe the actual ages given for them or not as you think best. Personally, I have my doubts, like a writer in the English magazine *Notes and Queries* for April 12, 1862, who questioned the contemporary data on centenarians and exposed one case as a fraud. Another correspondent in the same issue of that magazine ingenuously listed thirteen persons who were all alleged to be many years older than one hundred.

A few years ago there died in New York a centenarian, or near centenarian, for he was few months short of one hundred, who deserves special mention. This grand old man was Dr. Stephen Smith, whose life was notable not only for its great length, but also because of the almost continuous service he rendered to

the people, either as a physician or sanitarian. Stephen Smith was born in Onondaga County, New York, in 1823. In 1864 after he had been in the practice of medicine for several years and had already held positions of trust, he was made a member of the so-called "Council of Hygiene" for the city of New York.

As a result of the deliberations of this body and because of the stimulation of Dr. Smith, New York City established in 1866 its first Metropolitan Board of Health, with Dr. Smith as one of the original members. A few years later, in 1879, he became a member of the first and only National Board of Health in this country, though this board functioned for only four years. From 1893 to 1918 Dr. Smith was on the New York State Board of Charities, resigning when he was ninety-five years old. At the age of ninety-nine he was the guest of honor at the fiftieth anniversary meeting of the American Public Health Association, held in New York City.

This occasion was particularly appropriate for Dr. Stephen Smith, since in 1872 he had been the founder and first president of the American Public Health Association. A banquet of the association was held at the Hotel Astor in October, 1922, with that other nestor of the American medical profession, Dr. William H. Welch, presiding. Dr. Smith marched in during the course of the evening and calmly took a seat at the speakers' table, whereupon the diners threw calmness to the winds and gave him a great ovation. When he was called upon to speak, Dr. Welch tactfully suggested that he might remain seated if he preferred. Dr. Smith turned somewhat testily to his younger colleague, for Dr. Welch was then only seventy-two years old, and rather

brusquely informed him that he was not yet too old to talk on his feet. As one of those present I overheard this conversation, though I do not recall the exact words. Dr. Smith then stood up and for nearly half an hour read an excellent address which he had written, speaking in a firm and resonant voice remarkable in a man of nearly one hundred.

THE LONGEVITY OF PRESIDENTS

No other president of the American Public Health Association has lived as long as did Dr. Smith, but it is an interesting and probably significant fact that the presidents of this society of sanitarians have generally enjoyed long and fruitful lives. In a jubilee volume issued by the Association at the time of its fiftieth anniversary, biographical sketches of twenty-two of its former presidents are given. The average age of these gentlemen is about seventy-two years. Omitting Dr. Smith's ninety-nine years from the calculations, the average is over seventy years. Although the number is too small to draw statistical inferences, the fact that these men who were leaders in public health work lived such long lives might lead one to believe that a knowledge of hygiene and sanitation is somewhat conducive to longevity.

The life span of some of the great scientists who have contributed so much to the story of health are, in general, considerably in excess of the average length of life for their times. Florence Nightingale lived to be about ninety, while Lord Lister and Dorothea Dix were in their eighty-fifth years when they died. Alexis St. Martin of gunshot-wound fame, the human laboratory for Beaumont's experiments on digestion, lived to be

eighty-one. Edward Jenner was seventy-four and Pasteur seventy-three at death. Trudeau, a life-long invalid, died at sixty-seven, while Gorgas and Sedgwick were both sixty-six.

Of the twenty-seven presidents of the United States who have died, the average age is somewhat over sixty-eight years.* When they were inaugurated they would all have been expected to have lived a total of about three hundred and seventy-three years, according to the life tables, but actually this group survived for about four hundred and fifty-eight years, or eighty-five years more than the expectation. The oldest of our presidents at death was John Adams, who was ninety. The youngest was James A. Garfield, who was forty-nine, though his death was caused by assassination, as were also the deaths of Lincoln at fifty-six and McKinley at fifty-eight.

If the presidents are divided into two groups, those elected before the Civil War and those after that distressing event, a different picture is presented. The average of these pre-Civil War presidents was nearly seventy-four years, but those who were elected or who succeeded since that time show an average life span of only about sixty-two years. Furthermore, while the presidents prior to 1861 exceeded the total expectancy of life after the dates of inauguration, those who have held office since the time of Lincoln have lived on the average about nine years less than they should have according to the actuarial life tables.

The conclusions to be drawn from these interesting facts are to the effect that the office of president in

*"Longevity of the Presidents." *Statistical Bulletin,* Metropolitan Life Insurance Company. December, 1927.

these days is one of the dangerous occupations. This is an example of an environmental condition which may have a deleterious effect on the extent of life. The number of presidents considered, only twenty-seven, is of course not sufficient for statistical interpretation, but as the author who has assembled this data has pertinently written, "There is, to say the least, strong presumptive evidence that the duties of the presidency during the latter half of American history, have acted to produce a greater strain on human vitality than in the earlier era."

Our only living ex-president, Calvin Coolidge, was in 1930 fifty-eight. President Herbert Hoover was then fifty-six. The ages at time of inauguration and at death of the twenty-seven others were as follows:

	AGE WHEN INAUGURATED	AGE AT DEATH
John Adams	61	90
James Madison	57	85
Thomas Jefferson	57	83
J. Q. Adams	57	80
Martin Van Buren	54	79
Andrew Jackson	61	78
James Buchanan	65	77
Millard Fillmore	50	74
James Monroe	58	73
William H. Taft	51	72
John Tyler	51	71
Grover Cleveland	47	71
R. B. Hayes	54	70
W. H. Harrison	68	68
George Washington	57	67
Benjamin Harrison	55	67
Woodrow Wilson	57	67
Andrew Johnson	56	66

Zachary Taylor.......	64	65
Franklin Pierce.......	48	64
U. S. Grant..........	46	63
Theodore Roosevelt....	42	60
William McKinley.....	54	58
Warren G. Harding...	55	58
Abraham Lincoln......	52	56
C. A. Arthur.........	50	56
James K. Polk........	49	53
James A. Garfield.....	49	49

CAUSES OF DEATH OF CELEBRITIES

Many of the most famous persons in history have died from preventable causes, so that their deaths might at least have been postponed. Whether violence was a preventable cause in the old days, or not, may, of course, be a debatable question and fate may have been playing its usual inexorable part in removing from the world various celebrities such as Richard the Lion-Hearted and Gustavus Adolphus, two of the legion who were killed in battle, or Cæsar, Attila, Philip of Macedon, Edward II, and Lincoln, who were assassinated, or Hannibal, Nero, and Cleopatra, who committed suicide, or Jesus, Charles I, and Danton, who were executed.

Communicable diseases have taken the lives of a tremendous number of the great and illustrious of the world. Pericles and his son; the Emperor Claudius; the son of Cantacuzenus, the Byzantine emperor; and Louis X are only a few who died of plague, while smallpox caused the deaths of Queen Mary, wife of William III, who also had the disease; William II; and Louis XV. Among famous sufferers from this disease who recovered to die of other causes were Elfreda,

Louis XIV, and George Washington, while there is evidence that Rameses II may have had smallpox, as his mummy shows pock marks.

Typhoid fever claimed two daughters of Pasteur, and caused the death of Abigail Adams. Louis XIV had this disease as well as smallpox, and Edward VII nearly died of it. Louis IX succumbed to dysentery, as did his son. Obscure fevers caused the deaths of Mohammed, Alexander the Great, Benedict, Dante, Oliver Cromwell, and James I. Venereal disease was the ultimate reason for the deaths of such monarchs as Louis VII, Philippe VI, Francis I, and Ivan the Terrible, while some writers have alleged that Henry VIII really died of syphilis, or its aftermaths. One of his wives, Jane Seymour, succumbed to puerperal fever.

The elder brother of Henry VIII died of tuberculosis, as did also Edward VI, his son. More famous people have lost their lives from the white plague than any other one disease. In addition to the many mentioned in a previous chapter* there were John Paul Jones, Spinoza, Bishop Asbury, President Jackson, Irving, Chekhov, Thoreau, St. Francis, Cecil Rhodes, Dostoievsky, and Christy Mathewson, to enumerate only a few.

Pneumonia has, of course, been a frequent cause of death in the notable. This disease made an end to Charlemagne, Frederick the Great, both Presidents Harrison, Mary Baker Eddy, and Caruso. George Washington died of an acute inflammatory edema of the larynx and Longfellow of peritonitis. Cancer caused the demise of Napoleon and of U. S. Grant.

What was responsible for the deaths of many of

*See page 196.

those whose names have gone down into history will, of course, never be known, because of lack of reliable information, or because medical knowledge may have been inadequate at the time. Suffice it to say that many of these deaths were preventable when they occurred, and if they had been prevented, the whole course of history might have been different.

THE QUALITY OF LIFE

"It is not life to live, but to be well." So wrote a Roman philosopher, Marcus Valerius Martial, some two thousand years ago. What does it profit us or the world to prolong the length of life if we do not also improve its quality? Whether or not it is better to be dead at sixty or half-dead at eighty may be an open question, but no one will deny that a healthy and enjoyable long life is best of all.

There are persons who suspect or are even convinced that public health progress is detrimental to the race, or dysgenic, because the successful efforts of the sanitarian to reduce death rates and prevent diseases tend to promote the survival of the unfit, and produce a race of weaklings. It is argued that if the environment is permitted to overcome those who by themselves are too weak to cope with it, the survivors will form the nucleus of a strong and vigorous race. It is also argued that keeping people alive will in due time tend to overpopulate the earth.

These arguments are not sound. In the first place, it is a demonstrated fact that a fall in the death rate is invariably accompanied by a decrease and not a rise in the birth rate. Thus, the gain from fewer deaths is equalized to a certain extent by the loss in the number

of births, considering the population as a whole. This is a biological phenomenon, affected, however, by external influences, of which the conscious control of propagation is one.

Saving lives which are capable of being saved is worth while. The reduction in the incidence of diseases of early life such as scarlet fever, diphtheria, and the like means a diminution in physical defects which might otherwise be carried over as afflictions of later adult life. The practical extermination of such maladies as typhoid fever, malaria, hookworm disease, pellagra, and other diseases which are absolutely controllable would operate to rise and not lower the whole level of physical efficiency. So, too, the decrease in tuberculosis mortality means much to the vital capacity of the race as a whole.

The modern campaign against preventable disease must continue to be directed at the old enemies, but it must also be waged more assiduously against some of those which have not yet been attacked as vigorously as their records of destruction and incapacitation warrant. For many years tuberculosis was the "captain of the men of death," but in 1912 or thereabouts it was exceeded by heart disease as the chief cause of death in the United States. Tuberculosis is still the principal cause of death in early adult life, particularly between the ages of twenty and twenty-four, while heart disease wreaks its havoc after middle age, passing ahead of tuberculosis in the age group around forty-five years.

Next to heart disease the leading causes of death to-day are pneumonia, kidney diseases, cancer, tuberculosis, cerebral hemorrhage, and accidents. Heart disease, kidney disease, apoplexy, and cancer are not communicable or contagious and they are known as the

organic or degenerative diseases. If further progress is to be made in life conservations, particularly in the period past fifty, these ailments must be vanquished as effectively as have some of the transmissible diseases.

The control of these conditions depends partly upon environment and partly, no doubt, on inherent personal factors. The heart disease which is the end result of rheumatic fever caused in the first instance by neglected teeth is certainly preventable and should be prevented. Heredity, or genetics, also enters into this whole problem. If the transmission of defective genes, those elements which are the beginning of the organism, could be prevented, or the faulty genes themselves could be cancelled in some way, the race of the future would be much better equipped for survival and for physical progress.

It has been proposed that society cancel the bearers of defective genes. Not only has it been proposed, but in some places it has been done. Laws for the sterilization of mental defectives may be a step toward this end. Though such laws have been adopted in eighteen states, many have been held unconstitutional by the courts, others have been allowed to sink into a condition of desuetude, and a limited few have been enforced. Of late several such laws have been sustained by the judiciary, including the United States Supreme Court. The total number of persons sterilized so that they cannot propagate had been only about 6,000 at the end of 1928.

LIFE PROLONGATION AS A PAYING PROPOSITION

Saving lives is good business, not only for the person who has had the benefit of being saved, but for the nation as a whole. It is a sound economic proposition, en-

tirely aside from the more compelling humanitarian aspects. Statisticians have computed the monetary worth of the new-born babe at the astonishing figure of $9,333, basing this calculation on the amount necessary to be put at interest at 3½ per cent in order to raise the child to age eighteen and produce a net income throughout the working period of life.*

This estimate increases during early life until it reaches the peak of $31,900 at the age of twenty-five, declining gradually thereafter until it vanishes between the ages of seventy-one and seventy-two. At ten years the child is worth $19,078, about the same as the man is at forty-eight. Here are some of the figures on the economic value of a man in the $2,500 income class, based on the 1924 life tables:

AGE	VALUE
0	$ 9,333
5	14,156
15	25,341
25	31,900
35	28,750
45	22,000
55	12,900
65	4,400
70	562
75	minus 2,348

When these interesting computations are compared with similar figures based on 1901 life tables, it is found that the value of a male baby at birth in 1901 was $7,553, or $1,780 less than in 1924. During this period from 1901 to 1924 there has been a gain in the

*Dublin, L. I., and Lotka, A. J.: "The Money Value of Life and Life Extension." *American Journal of Public Health,* June, 1927.

expectation of life of about nine years. The statistical experts conclude, therefore, that the net value of life prolongation has amounted to the amazing sum of $2,300,000,000 for males alone. When the worth of females, somewhat lower, we regret to state, than males, is added a grand total of $3,450,000,000 is reached. If these figures are correct, and there is no reason to doubt either their accuracy or the theory upon which they are based, the economic value of life extension is apparent.

"Life," wrote the poet, "is the gift of God and is divine." This is true, no doubt, but a gracious Deity has placed in the hands of man the instruments to prolong life and to enhance its value and excellence. He has also given to man the intelligence to use those instruments. Sanitary as well as moral and spiritual decadence has reduced more than one proud empire to the dust, but man possesses the gift to avert such disasters. Not only that but it is within his power to improve the quality of his kind and in so doing to accomplish the true will of the Almighty. "Men who are occupied in the restoration of health to other men, by joint exertion of skill and humanity are above all, the great of the earth," wrote Voltaire. "They even partake of the Divinity, since to preserve and renew is almost as noble as to create."

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